Pit and Quarry

SAND ▪ GRAVEL ▪ STONE

HANDLING ▪ CRUSHING ▪ SCREENING ▪ WASHING

The Shortest Route From Pit to Plant Is Taken By the

Sauerman Dragline Cableway Excavator

Sand and gravel producers employing this excavator are using the minimum amount of labor and machinery because one man operating a double drum friction hoist digs, conveys, elevates and dumps in one continuous forward operation. The machine is equally efficient in either wet or dry pit excavation.

If interested in this machinery write us your conditions and requirements and we will advise you.

SAUERMAN BROS.

312 S. Dearborn St. Chicago, Ill.

Manufacturers of Dragline Cableway Excavators, Power Scrapers and Cableway Accessories

Cableway Excavators, Power Scrapers and Cableway Accessories

DECEMBER, 1918

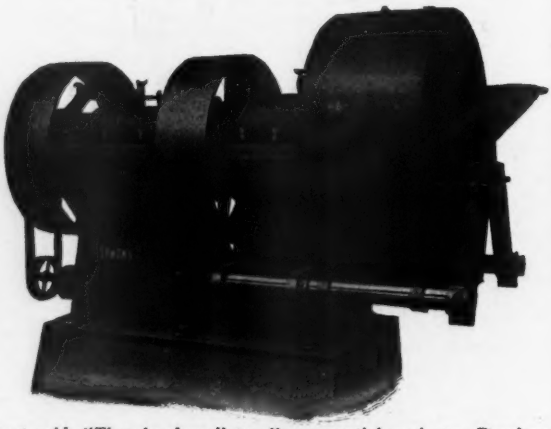
Table of Contents - - Page 17

Index to Advertisements - Page 17

Uncle Sam is Now Saying "Thumbs Up" to Something Like $250,000,000 of Road Work

Are You Prepared for Your Share?

The Symons Disc Crusher



with its high efficiency and economy in the crushing of rock and the production of gravel, affords attractive prospects for a profitable participation in the general prosperity which will attend the resumption of the nation-wide road building plans, which have been held in abeyance since the Government said, "Thumbs down" to all unessential projects. Previous to that action, a detailed survey of the Nation's road building plan indicated an expenditure of $250,000,000.00.

Think what this will mean in the demand for road building materials, such as sand and gravel, as well as the general demand which will spring from the concrete construction field. In this connection remember that the Symons Disc Crusher is one of the most efficient equipments of its kind on the market.

There are a large number of points of superiority which we will explain to you in detail if you will write us.

It is built in four sizes and with capacities of 5 to 120 tons per hour.

Let us describe it to you fully. Ask for Catalog "R."

CHALMERS & WILLIAMS

1430 Arnold Street **Chicago Heights, Ill.**

THE SCOOP CONVEYOR

OVER 1000 USERS
FIND IT INDESPENSABLE IN STORING AND RECLAIMING, IN LOADING AND UNLOADING CARS TRUCKS AND WAGONS

DOES THE WORK OF FROM
6 TO 12 MEN
AND KEEPS EQUIPMENT MOVING —

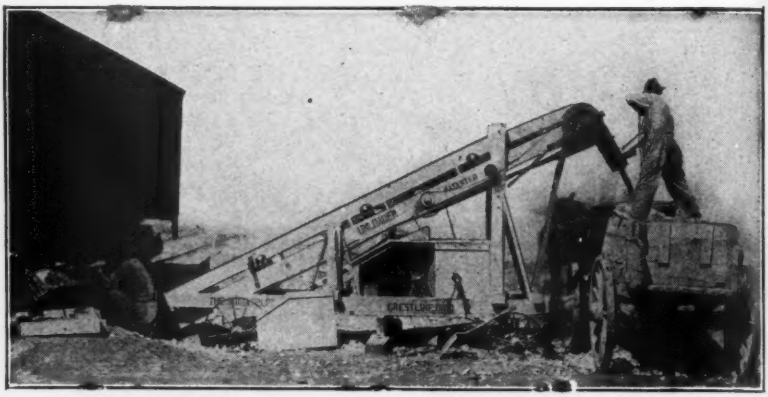
OVER 50% OF USERS SEND US "REPEAT" ORDERS

PAT ALLOWED
OTHER PAT'S PENDING

Ask for Our Literature

PORTABLE PQ.
MACHINERY COMPANY,
PASSAIC, N. J.

A Yard a Minute—



will keep the wagons moving. That rate of speed is easily averaged with the

BURCH CAR UNLOADER

Some users exceed that pace. Fast loading is necessary, but low operating cost of the machine is essential. The simple, practical design of the "Burch" eliminates the need of several shovelers. It is sturdy and compact, capable of withstanding the most severe use.

You ought to also know about our stone spreader used in connection with motor truck in spreading stone or gravel on road.

Write for Complete Details

THE BURCH PLOW WORKS COMPANY - - CRESTLINE, OHIO

Continental Cars ———

for all kinds of

Quarry Service

CONTINENTAL CARS are noted for their ruggedness, simplicity of design, ease of dumping and righting, and their ability to stand up under the heaviest steam-shovel work.

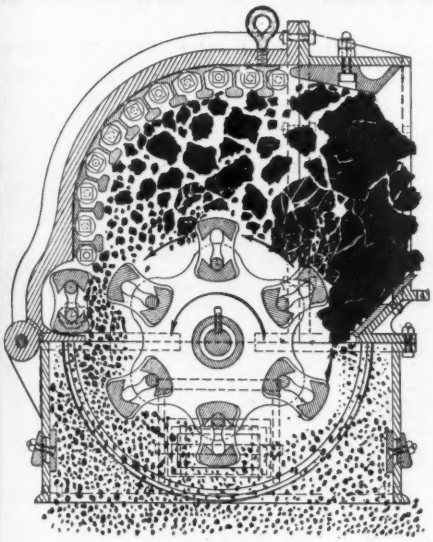
Large wheels and heavy truck construction make CONTINENTAL CARS cling to the track.

MALLEABLE CASTINGS reduce the maintenance cost to a minimum. *Send us your inquiry.*

Continental Car Company of America, Incorporated

Main Office and Works, Louisville, Ky.

Brainard Impact Coal Crusher



WILL CRUSH
RUN OF MINE
COAL
TO A
Uniform Size
With less than 7% under 1-4 inch

Send for Bulletin No. 10

BRAINARD Pulverizer Co.
37 W. Van Buren St., Chicago, Ill.

ADAMITE

Cement Mill Tires and Rolls

Sand Mill Rolls

"ADAMITE" A high-carbon alloy of chromium and nickel made under the U. S. and Foreign Patents. It is hard, yet tough, strong and resists wear and abrasion better than any other material.

Write for Booklet

PITTSBURGH IRON & STEEL FOUNDRIES CO.
Sales Offices, Pittsburgh, Pa. General Offices and Foundries, Midland, Pa.

Universal Crushers

are built in 25 sizes portable or stationary, and are **Money Makers** for Pit men to crush their oversize and Quarry men to enable them to produce small crushed stone for the concrete man, road builder and contractor.

Machines can be adjusted while running, to produce material varying from 3 in. to as fine as ¼ in. in one operation.

Capacities from 5 to 300 tons per day. Jaw openings 5x6 to 14x24 inches equipped with manganese jaws and removable bronze bearings.

Send for Catalogue of full line of Universal and Eureka crushers, rolls for fine grinding, Elevators and screens of all sizes, also full line of Universal Pulverizers for the manufacturing of Agricultural Limestone and the grinding of other fine materials.

UNIVERSAL CRUSHER CO.
200 Third Street, Cedar Rapids
Iowa, U. S. A.

TRAYLOR
Gyratory Crushers

with their extra large shafts—eccentric both longer than others and of greater diameter, entirely submerged in the lubricant

ASSURE YOU

of a cool running Crusher, having the maximum capacity with the cost of upkeep reduced to the minimum.

Bulletin QG-4—It's New
Get It.

Traylor Engineering & Manufacturing Co.

Main Office and Works:
Allentown, Pa., U. S. A.

New York Chicago Los Angeles Spokane

The Largest Agricultural Limestone Producers

USE

The Bradley Three Roll Mill

This mill is in use by more large producers than any other machine made—produces more material and at a lower cost.

No auxiliary machinery or screens needed to procure the very finest finished product—takes rock ¾" in diameter and reduces to shipping fineness in single operation.

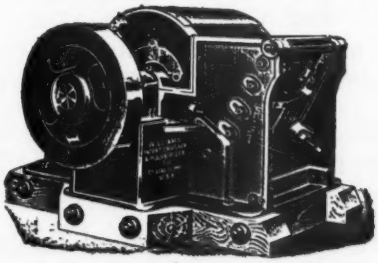
The Demand for Finely Ground Limestone Is Increasing. Why Not Prepare Now?

Send for Catalog No. 42—Our Engineering Dept. Is at Your Service

Bradley Pulverizer Co.

BOSTON **London** **Works—ALLENTOWN, PA.**

FROM 14" TO 18" CUBES TO 1½"- 1"- ¾"- ½" IN ONE OPERATION



BY using Williams Jumbo Crushers to take the feed from the very large Gyratory Crushers, the smaller or intermediate crushers, which were formerly necessary, can be eliminated as the Williams Jumbo Crusher will reduce these large cubes ranging in size from 14" to 18" to a product either 1⅛"-1"-¾" or ½". Capacities from 60 tons per hour to 200 and 300 tons per hour. Complete description of this extraordinary crusher is given in

BULLETIN NO. 85

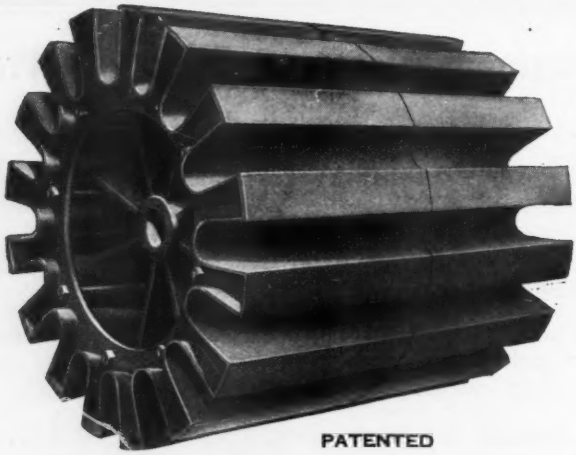
THE WILLIAMS PAT. CRUSHER & PULVERIZER CO.

Gen'l Sales Dept., Old Colony Bldg.,

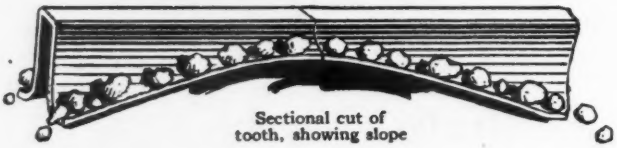
CHICAGO

Plant: St. Louis, Mo.

7 Second St., San Francisco, Cal. First National Bank Bldg., Denver, Colo.



PATENTED



Sectional cut of tooth, showing slope

The "Black" Elevator Boot Pulley

Entirely eliminates the trouble and much expense and loss of time caused by shut downs due to the replacing of elevator belts in crushing plants.

These belts wear out rapidly due to the cutting and bruising action of stones which fall between the belt and boot pulley.

Insure yourself NOW against further loss. Our new catalog explains the special advantages obtained by their use. Write for copy.

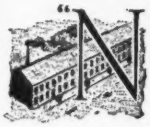
Allis - Chalmers Manufacturing Company
MILWAUKEE, WIS.

OFFICES IN PRINCIPAL CITIES

Canadian Business Refer to CANADIAN ALLIS-CHALMERS, Ltd., TORONTO, ONT.

WORTHINGTON

Keeping ahead of the country



"NOTHING succeeds like success"—this is in brief the story behind each of the plants grouped under the Worthington name.

For each has, through many years, held its own high place in the esteem of American industry; indeed each was called into being by some vital need of industry, and you will find our products in the service of countless important branches of the country's production.

And because our products are such necessary partners in so many and so varied interests, our growth has fairly paralleled the nation's industrial development. From modest beginnings to eight great plants, each both pioneer and leader in its field, each under a common name preserving past traditions of service and satisfaction—this is the concrete measure of Worthington success, and a hint as well of the even larger part to be played in the future.

WORKS

Worthington Works
Harrison, N. J.

Blake-Knowles Works
E. Cambridge, Mass.

Power & Mining Machinery Works
Cudahy, Wis.

Ingeco Engine Works
Cudahy, Wis.

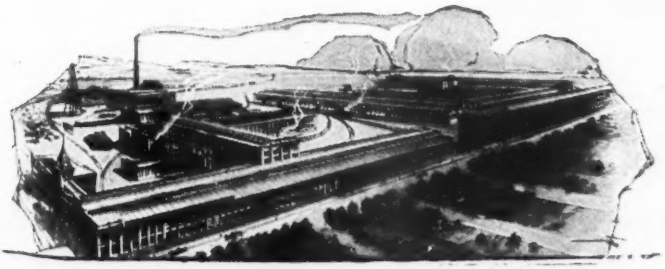
Deane Works
Holyoke, Mass.

Laidlaw Works
Elmwood Place
Cincinnati, O.

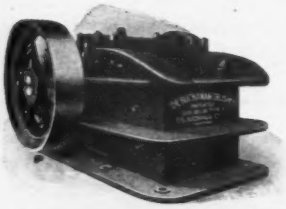
Snow-Holly Works
Buffalo, N. Y.

Hazleton Works
Hazleton, Pa.

Worthington Pump and Machinery Corporation
115 Broadway, New York City
Branch Offices in 24 Large Cities



Largest Makers of Pumping and Mining Machinery

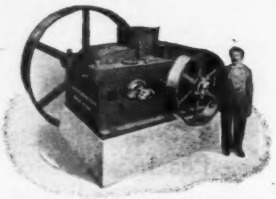


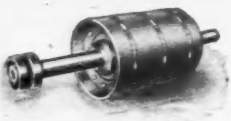
Buchanan All-Steel Crushers

Type B—12 sizes, from 5x12″ to 24x36″. Manganese Steel wearing parts, Water Jacketed Bearings, Parting Pitman in larger sizes, adjustable jaw stroke. Type C—24 sizes, 24x36″ to 60x84″.

Buchanan Crushing Rolls

Type C—sizes from 18x12″ to 42x16″. Type C Special from 42x18″ to 72x24″. Phosphor Bronze Bearings, Chrome Steel Tires, Patent Swivel Bearings, Fleeting Adjustment, Dust Covers.

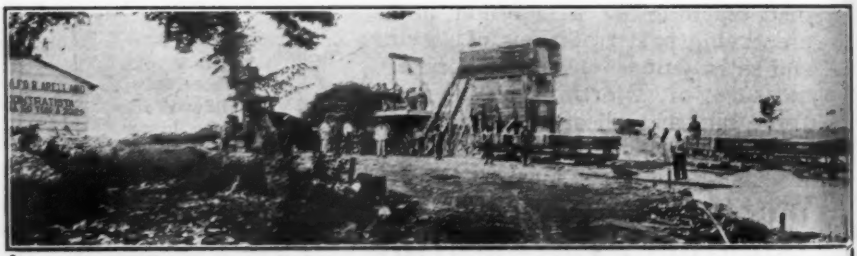




Buchanan Magnetic Separators and Magnetic Pulleys

Protect your machinery against breakage from tramp iron and steel.

C. G. BUCHANAN CO., Inc., 90 West St., New York, U. S. A



Construction and Highway Building

Unprecedented business is expected to follow peace.

More housing facilities are needed—for homes and industry. More highways are required for heavy overland traffic.

Rock Products will be in enormous demand.

There is Austin rock crushing and handling equipment for every need.

Send for Catalog 27 describing and illustrating our Gyratory Crushers, Elevators, Screens, Bins, and Stone Spreading Wagons.

It gives typical Austin complete rock crushing plant installations that have increased capacity while cutting costs.

Austin Manufacturing Co., Chicago

Sales for FRANCE, SPAIN, ITALY, PORTUGAL, BELGIUM and their Colonies, THE WEST INDIES and CHINA handled by
ALLIED — ALLIED CONSTRUCTION MACHINERY CORPORATION — ALLIED
120 Broadway, New York, U.S.A.

DUPLEX 4-WHEEL DRIVE

11th YEAR

"I Know Where the Duplex is Every Minute of That 100-Mile Trip—It Never Fails"

The *power to endure* is a Duplex ideal—planned for, inbuilt and evident in its 4-wheel drive construction.

The *power to endure* influenced Duplex design, dictated the materials and dominates its construction.

The *power to endure* has been proven in countless ways, in four seasons and on a thousand roads;

—in oil fields, in lumber camps, in mining districts;

—in snow and blizzards of the North, in mud and swamps of the South, in sand and gumbo of the West.

The *power to endure* has made the Duplex 4-Wheel Drive a super-truck; it has earned for the Duplex the premier position in Truckdom.

The power to endure is claimed for all trucks. Many, no doubt, strive to embody it. In the Duplex it is *real.*

DUPLEX TRUCK COMPANY
2052 Washington Ave.
Lansing, Mich.

With tire mileage greater—
And fuel consumption less—
Duplex cost per ton-mile is always lower.

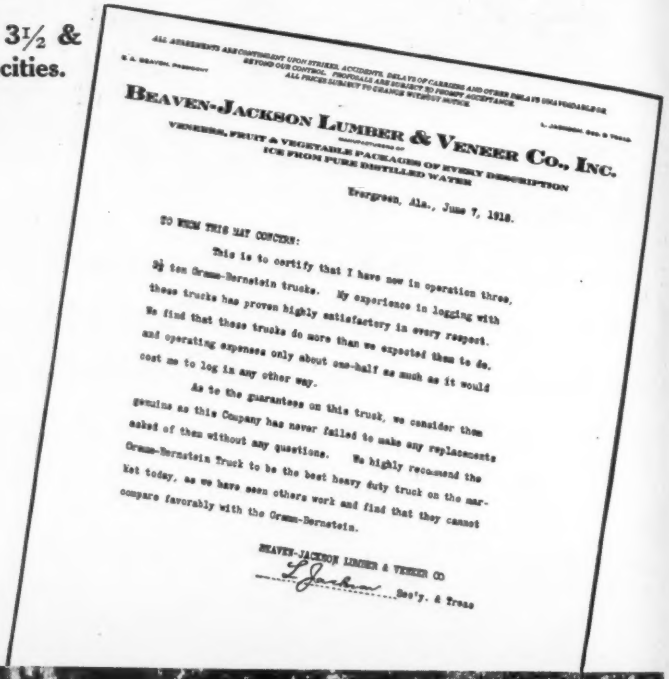
DUPLEX FOUR WHEEL DRIVE TRUCK

"The Best Heavy Duty Truck on the Market"

That's the verdict of the Beaven-Jackson Lumber & Veneer Company based on their experience with 3 Gramm-Bernstein Trucks in the difficult service of logging.

You should know what they can do for you.

1, 1½, 2, 2½, 3½ & 5 Ton Capacities.



ALL AGREEMENTS ARE CONTINGENT UPON STRIKES, ACCIDENTS, DELAYS OF CARRIERS AND OTHER DELAYS UNAVOIDABLE OR BEYOND OUR CONTROL. PROPOSALS ARE SUBJECT TO PROMPT ACCEPTANCE. ALL PRICES SUBJECT TO CHANGE WITHOUT NOTICE.

BEAVEN-JACKSON LUMBER & VENEER CO., INC.

VENEERS, FRUIT & VEGETABLE PACKAGES OF EVERY DESCRIPTION
ICE FROM PURE DISTILLED WATER

Evergreen, Ala., June 7, 1918.

TO WHOM THIS MAY CONCERN:

This is to certify that I have now in operation three, 5½ ton Gramm-Bernstein trucks. My experience in logging with these trucks has proven highly satisfactory in every respect. We find that these trucks do more than we expected them to do, and operating expenses only about one-half as much as it would cost me to log in any other way.

As to the guarantees on this truck, we consider them genuine as this Company has never failed to make any replacements asked of them without any questions. We highly recommend the Gramm-Bernstein Truck to be the best heavy duty truck on the market today, as we have seen others work and find that they cannot compare favorably with the Gramm-Bernstein.

BEAVEN-JACKSON LUMBER & VENEER CO
L. Jackson Sec'y. & Treas

The Gramm-Bernstein Motor Truck Co.

Lima, Ohio

Heavy Strain of Quarry Haulage Emphasize the Quality of the

FEDERAL

In many of the leading quarries of the country the Federal Truck has shown its superior qualities—has proved beyond question that it does the work efficiently and most economically.

The unusual ruggedness of the Federal, combined with its durability and ease of operation, make it a favorite in the heaviest kinds of haulage.

Write us and we will send you regularly the magazine, "Traffic News"—a publication for truck owners and buyers.

Federal Motor Truck Company
44 Federal Street, Detroit, Michigan

Another FEDERAL

2-Ton Federal operated by Peter Zaiu for hauling granite at Quincy, Illinois. Always on the job!

One to Seven Tons *Return Loads will cut your costs*

KEYSTONE 10-TON TRACTION STEAM SHOVEL

HERE IS A LIGHT TRACTION STEAM SHOVEL that will go anywhere you could take a loaded dump wagon. A 15-mile jaunt in ten hours, over decent roads, is easy for it.

IF YOU HAVE A STRIPPING JOB, or if you wish to accurately separate two strata of clay or sand, the flat bottom half-yard SKIMMER SCOOP will do your work as nothing else could.

IN SHALLOW CUTTING, 6 in. to 2 ft., this little shovel will beat the big ones in daily output. Its 16-ft. boom and 11-ft. horizontal crowding movement give it the bulge on shallow work.

And it will DRIVE ITS SCOOP INTO THE TOUGHEST FIRE-CLAY, gravel, shale or anything, in fact, but solid rock.

There are dozens of KEYSTONE excavators DIGGING BITUMINOUS COAL, in open pits.

You can LOAD FROM STORAGE PILES of crushed stone, sand, gravel or coal, into freight cars, industrial cars or wagons.

And you can get around quickly from your quarry to your storage dump and vice versa.

AGAINST A HIGH BANK of sand or clay, where all strata are to be mixed in digging, you would, of course, use the DIPPER SCOOP, which works like the ordinary type of steam shovel.

When necessary to cut below grade, as in working around the top of your quarry face, you should use the DRAW DITCHER SCOOP, which is a positively controlled dragline attachment, cutting toward the machine and to a depth of 16 feet below grade.

The machine can be thus equipped WITH THREE DIFFERENT SCOOPS AND ATTACHMENTS: The Skimmer, Dipper and Ditcher. They are inexpensive and you can change from one to another in a few minutes. The cost is low.

It will give you confidence to know that, while the Keystone Shovel is comparatively a newcomer, there are already over 400 of them in use among contractors and quarrymen, and they have won enthusiastic approval.

Besides, the machine is sponsored by the Keystone Driller Co., which is by no means a newcomer in the manufacturing field, having been in business at Beaver Falls, Pa., since 1882.

The photographs reproduced in OUR SHOVEL CATALOG show the machine on dozens of different jobs and they will show you more in a minute than we could tell you in an hour. They are supplemented by many pages of cuts reproduced from drawings prepared by our Engineers. The accompanying text is fully descriptive and contains such data as you will require to determine what could be expected of the Keystone Excavator on your work. Drop us a line NOW.

KEYSTONE DRILLER CO., Beaver Falls, Pa.

170 Broadway, New York City
Monadnock Block, Chicago
Joplin, Mo.

Because—

DYNAMITE

Will Do Your Work Right

is the reason you should use it. We have a variety of grades—they will suit your particular needs, no matter in what manner they are connected with blasting.

Many users have individual blasting problems to solve. To such, we offer our consultation services, and we will also make an exhaustive study of your requirements, gratis. Then our recommendation of proper grades is at your disposal—whether you take advantage of it or not.

Could you ask for more?

ÆTNA EXPLOSIVES COMPANY

Incorporated

120 Broadway New York City

Telsmith

Pit and Quarry

A Monthly Journal for Producers of Sand, Gravel, Stone, Cement, Gypsum and Lime
Member Audit Bureau of Circulations

VOL. 3 CHICAGO, ILL., DECEMBER, 1918 NO. 3

CONTENTS

Unique Gravel Plant 71
Substitutes for Nitric Explosives 74
Wisconsin Granite Operations 78
Lime Production in the United States 81
Modern Management Applied to Quarrying 82
Maintenance of Highways 85
Editorial 86
Labor Saving in Limestone Quarrying 88
Association Activities 92
Stone Production in 1917 94
Chamberlain-Dent Highway Bill 96

Index to Advertisers

Ætna Explosives Co., Inc. 15
Allis Chalmers Mfg. Co. 8
Atlas Powder Co. 00
Austin Mfg. Co. 10

Ball Engine Co. 18
Bell Locomotive Works 29
Bradley Pulverizer Co. 7
Brainerd Pulverizer Co. 5
Burch Plow Works Co. 4
Burnham, Royal E. 29
Buchanan, C. G., Co., Inc. 10

Caldwell & Son Co., H. W. 19
Calumet Iron & Steel Co. 27
Chalmers & Williams 2
Chicago Perforating Co. 29
Continental Car Co. of America ... 4

Daniels, Oscar 27
Donahue & Co. 26
Du Pont de Nemours & Co., E. I. .. 37
Duplex Truck Co. 11

Erie Pump & Engine Works 32
Erie Steam Shovel Co. 18

Fate Co., J. D. 33
Federal Motor Truck Co. 13

Gramm-Bernstein Motor Truck Co. .. 12
Grasselli Powder Co. 36

Haiss Mfg. Co., Geo. 23
Hendrick Mfg. Co. 31
Hercules Powder Co. 00

Kennedy-Van Saun Mfg. & Eng. Corp. 18
Keystone Driller Co. 14
Kleinhans Co. 24
Koppel Industrial Car & Equip. Co. 30

Lewiston Foundry & Mach. Co. 21

Machinery Warehouse & Sales Co. .. 25
Mansfield Engineering Co. 26
Michigan Dredge Co. 34
Moore Bros. 27
Morris Machine Works 16
Mundy Hoisting Engine Co. 23

Osgood Co. 34
Orenstein-Arthur-Koppel Co. 30

Pittsburgh Iron & Steel Foundries. 5
Portable Machinery Co. 3
Power Manufacturing Co. 32

Sauerman Bros. ..... Front cover
Sterling Motor Truck Co. 00

Traylor Engineering & Mfg. Co. 6

Union Chain & Mfg. Co. 29
United States Rubber Co. 28
Universal Crusher Co. 6
Urschal Bates Valve Bag Co. Back cover

Victor-Balata & Textile Belting Co. 31

Williams Patent Crusher & Pulv. Co. 7
Worthington Pump & Mchy. Co. ... 9

Zelnicker 26

PIT AND QUARRY is published at 875 Rand-McNally Building, Chicago, Ill. Subscription price, $1.50 per year. Contributors and advertisers should have copy in the office by the 15th of month preceding publication, as forms close at that time.

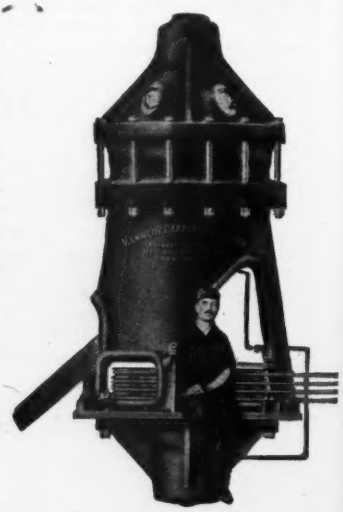
The Machine that meets the demand of years is here

The KENNEDY GEARLESS CRUSHER

ONE Crusher of this type has a capacity, when crushing to ¾ inch and finer, of approximately SIX No. 3 Gyratory Crushers, giving an enormous output of fine product.

It is a strong, rigid machine, made throughout of best materials. Is driven by one belt or rope sheave. Power required is little for the tonnage produced. Crushing parts are entirely enclosed, making machine practically dustless.

These are only a few of the advantages of this remarkable Crusher.



We have the largest line of Mining, Crushing and Cement Machinery of any concern in the world. Send us your inquiries.

Ask for Catalogue No. 24.

Kennedy-Van Saun Mfg. & Eng. Corp.

Equitable Building **New York City**

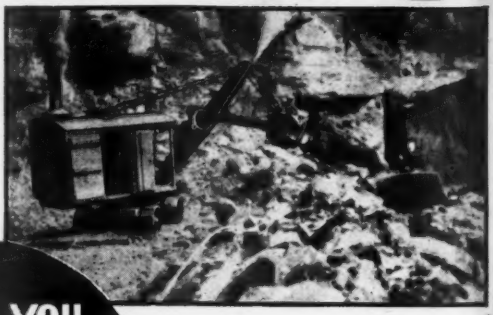
ERIE Revolving Shovels

BALL Engine C Erie, Pa.

If your rock blasts down in big chunks that are hard to load, you will be interested in the experience of George R. Dempster:

"We are handling rocks that would scare a 95-ton steam-shovel. I know that there is not a machine in the country that will crush the rocks which our 20-ton ERIE Shovels will lift."

GEORGE R. DEMPSTER, Knoxville, Tenn. Owner of four Erie Shovels.



Have you big rocks that are hard to handle?

The ERIE Shovel is built for heaviest quarry service. An ERIE will assure you of a steady output, independent of labor conditions.

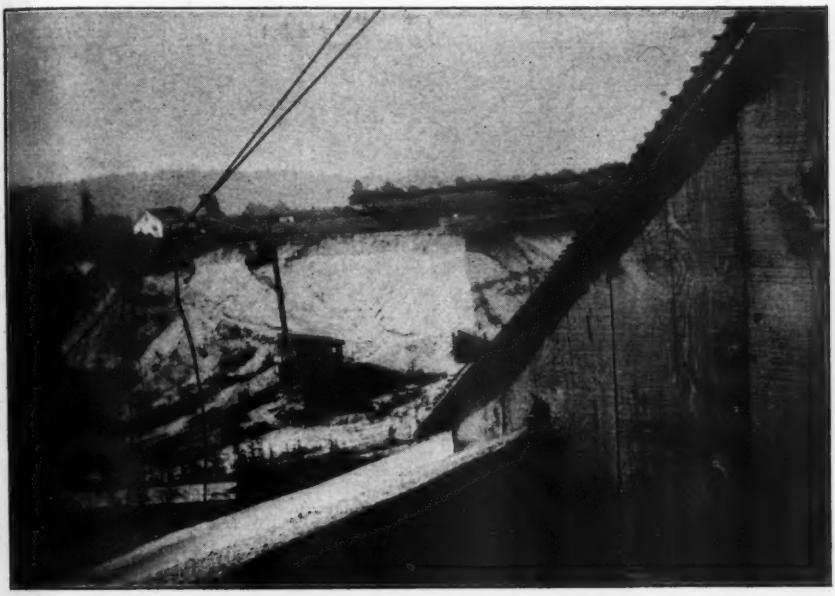
It's worth investigating. Write for a copy of our Bulletin Q.

Address:

BALL ENGINE CO., ERIE, PA.
Builders of ERIE Shovels and Cranes; BALL Engines.

Pit and Quarry

Vol. 3 Chicago, Ill., December, 1918 No. 3



Pit of Contractors' Stone and Gravel Co. at Broadwell (Ancor), O.

A Unique Gravel Plant

Operations of the Contractors' Stone and Gravel Company Near Cincinnati.

AT a little suburban stop on the railway out of Cincinnati, known as Broadwell, there is in operation a sand and gravel pit whose legal situation while the war was at its height was indeed unique. This because its location was at the very heart of one of the largest tracts taken over for munition-making by the government. Far as the eye can see Uncle Sam acquired the land about, and only a short time ago, while barracks for laborers were rising with unexampled speed, ground was being cleared and work actually started on a gigantic air-nitrate manufacturing establishment. It was believed then that the big gravel pit, belonging to the Contractors' Stone and Gravel Company of Cincinnati, would also be taken over by Uncle Sam, but it has continued its operations uninterruptedly. Work has

Views from Top of Crusher House

now stopped on the proposed nitrate plant, and it is believed that the government has given up that project. At any rate, the Cincinnati Chamber of Commerce and like organizations are trying to arrange for some great steel or chemical plant to take over the proposition. Meanwhile the gravel plant will doubtless proceed as before the war.

Cincinnati, long a center for building operations, lies, roughly speaking, between the two Miami rivers, and these, in turn, make their way through extensive gravel deposits. This gravel is very easily obtainable with proper equipment, and so, among others, out at the heart of this Little Miami Valley—to the eastward of the city—the Contractors' Stone and Gravel Company has operated for many years.

Its big gravel pit at Broadwell—or Ancor, as it is now called—has long been a landmark with every passer through the valley, motorists and others being wont to stop and, securing permission, climb the stairs to the top of the crusher, to enjoy the view over the cornlands. This valley-bottom is, indeed, a notable corn country. Thanks to the annual freshets refertilizing the land each year, 60 to 75 bushels to the acre can be produced.

Here and there in this fertile region great gravel deposits crop out, and that these are prolific is evidenced in the fact that just this one concern loads, at minimum, ten cars of gravel a day. A drag scraper runs against the banks, secures its load and then dumps this into a car waiting to carry it up an incline to be washed. When so cleaned it is dropped into railway cars near and then sent on its way. The large gravel is sent to the crush-

ers, of which there are two—a Symons No. 24 disc and a Farrell No. 15 jaw crusher. It is 70 feet from the base of the pit, or hole, to the top of the crusher house.

The company uses a washer patented by Frank Cornell, head of the concern. This consists, basically, of a screen revolving in water, and the one used here is the only one of the sort extant. An automatic-feed is used to feed the gravel into the washer; this is also Mr. Cornell's design. So, too, he uses a dump-cart of his own designing, which dumps and closes automatically. As he puts it, when he opened the plant out there he was far from the city's heart, and found that he achieved best results with his own designs. In this way he also improvised various modifications of the usual types of drag-line scrapers until the result became substantially his own make. Ten scrapers of this new pattern have been built and are put to use.

"With these scrapers," Mr. Cornell said, "we pull in by means of a gin-pull, and then dump out from the back end. We use a draw-car for the hill; but this is fitted with an automatic dump, also of our own make. This is constructed in such wise as to be almost wholly automatic; the load comes up, hits a 'trick' and dumps, and then reverses the engine, at the same time closing the door. No belting is used, except, of course, to drive the machinery. With this equipment we can handle easily 600 tons of material a day; and lately, with Uncle Sam requiring all we could give, we ran both day and night capacity shifts."

British Concrete Ships.

Reinforced concrete vessels to the number of 220, representing some 200,000 tons of shipping, were under construction last month in the United Kingdom. According to the *London Times*, the capital outlay for these ships, aside from cost of land and shipyard plants, was estimated to be nearly $20,000,000. On the designs adopted the saving of steel is stated to be fully 70,000 tons on what would be required for steel ships of the same carrying capacity.

"Pit and Quarry" Over There.

CORP. LEWIS A. ADAMS, assistant superintendent of the Ohio Quarries Company, Amherst, O., who has been with the famous Quarrymen's Regiment from its organization, has always been a close reader of PIT AND QUARRY and had paper forwarded to him wherever that gallant and efficient body of fighters and workers were ordered to do their bit. In an appreciative letter to the editor he writes:

"I have read with great interest the copies of PIT AND QUARRY that were forwarded by my father, and you will be glad to know that several of the boys also found much pleasure in reading them.

"The 28th Engineers, or the 'Quarrymen's Regiment,' is over here and getting out rock. My company operated two quarries on the coast at a port of debarkation for two months. The rock quarried was used for road construction and maintenance. It was a different proposition from quarrying in America, but we delivered the goods.

"We are now in the zone of advance and are operating a quarry. The rock removed is used for road purposes. It is a hand job all the way through—pick and shovel work. The rock is a limestone and it is broken up and imbedded in layers of clay. The large stone is used for Telford base work, the smaller stuff being napped up by hand into macadam. We are making a good output in spite of handicaps of mud and rain."

Substitutes for Nitric Explosives

Liquid Oxygen, or Oxyliquit, Has Some Advantages but Many Limitations.

THE recent industrial exploitation in Germany on a large scale of a new explosive is interestingly described in a lengthy article in the French engineering journal, *La Genie Civil*, a translation of which appears in Scientific American Supplement No. 2234. But for the war this new explosive, which the Germans call oxyliquit (liquid oxygen) or *sprengluft* (explosive air), would undoubtedly have long remained without practical value. From the beginning of hostilities, however, military necessity compelled the German authorities to requisition the entire stock of nitric explosives. Private industries (coal mines, potassium mines, stone quarries, etc.) which used large quantities of these were therefore compelled to look for some substitute. This was a favorable occasion for German engineers, who for about fifteen years had worked on the problem of oxyliquit, to give their products a trial. The principle of the new explosive is entirely different from those upon which all others are based, as will appear from the following abstract.

INDUSTRIAL or military explosives are generally substances (mixtures or definite compounds) containing two essential constituents, a combustible element, carbon, and an ignition element, oxygen. The explosion is the result of the abrupt and violent combination of these two elements.

Oxygen is introduced under the form of nitric combination (nitric ether, nitric derivatives, nitrates) or chlorinated combination (chlorates or perchlorates); carbon in form of an organic matter (cotton, phenol, toluene, etc.). It is therefore easy to see that in ordinary explosives the combination of the active elements carries with it a considerable dead weight, constituted by the other elements (nitrogen, chlorine, potash, etc.).

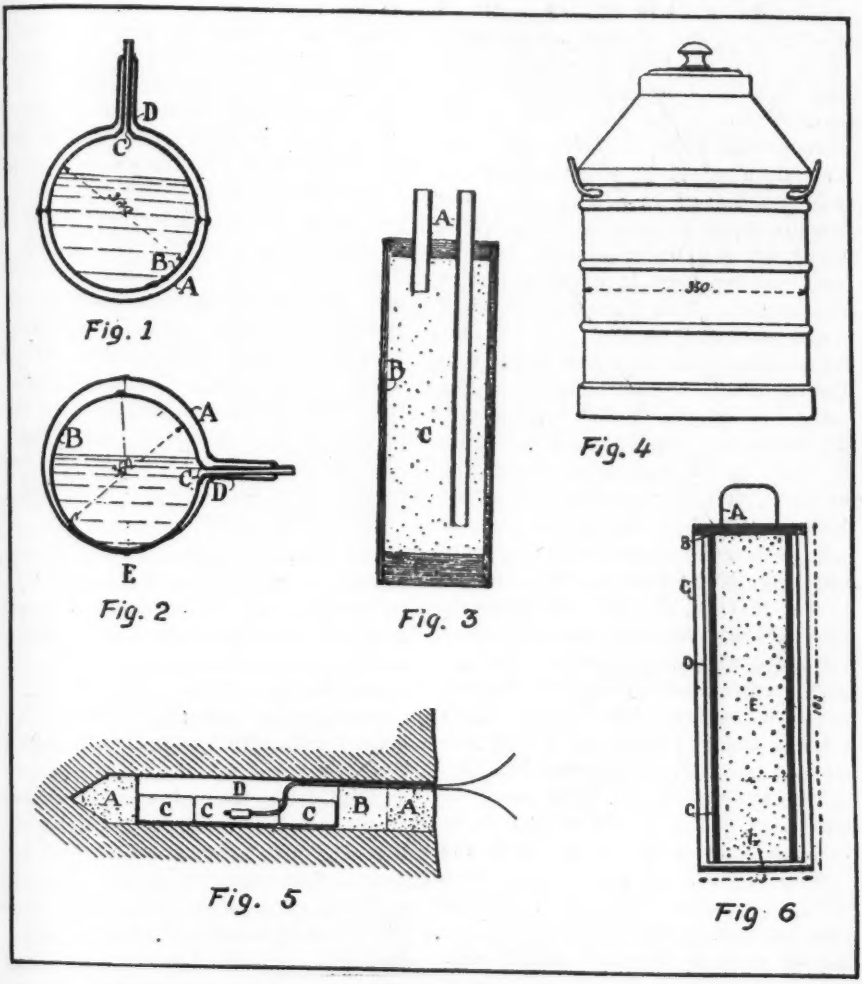
It is not so with oxyliquit; here the liquefied oxygen is put in contact with carbon in a divided and porous form. Under a system of ignition the combination takes place with explosion, and in principle the procedure is perfect. In the evolution of this process, however, which was first invented by Linde in 1895, many difficulties were encountered.

Liquid oxygen is always produced on the spot where it is to be used, as it is impossible to keep it very long, notwithstanding all the precautions taken against volatilization. It is prepared by liquefying the air, the mixture so obtained of liquefied nitrogen and oxygen being submitted to a partial distillation, which eliminates the larger part of the nitrogen, more volatile than the oxygen. The resulting bluish liquid contains about 85 per cent of oxygen.

The German society for the exploitation of the Linde patents is able to furnish installations giving an hourly output of 10 kg. (23 lb.) of liquefied rectified oxygen. The price would be about 25 centimes per kilogram, including amortization and interest on capital invested.

To transport the liquefied oxygen from the place of production to the place of utilization, mine or quarry, a new container was necessary.

In the laboratory, glass vessels, so-called "Dewar" bottles, having double walls with a vacuum between, have been used for the keeping of liquefied oxygen. These bottles are not closed —on account of the danger of a closed bottle in handling—but, thanks to the good insulation, the loss of oxygen by



METHODS OF TRANSPORTING AND USING OXYLIQUIT

Figs. 1, 2. Bottles for transporting. 3. Kowastosch cartridge. 4. Vessel for immersion. 5. Charging a bore hole—A, tampon of hard clay; B, tampon of soft clay; C, cartridges; D, primer and ignition fuse. 6. Messer cartridge (Marsit method)—A, wire handle; B, waterproof cardboard; C, waterproof paper; D, ordinary paper; E, lampblack; G, permeable covering.

evaporation is very small (about 50 grammes per hour, or 17.5 oz.).

These glass bottles, easily breakable, are not convenient for wholesale manufacturing nor for use in the workshop. They are now replaced by containers of metal—especially brass and steel—and these give excellent service.

The steel or brass bottles do not hold the vacuum as well as those of glass—being more porous—and the vacuum must be often renewed. To lessen this inconvenience, Dewar inserts between the walls very porous charcoal.

When the vacuum is made and the

bottle filled, the annular space between walls takes a temperature of —190° C. (—372° F.), the normal boiling point of the liquid, and the charcoal gets extremely porous, and absorbs with great avidity the little gas that passes through the pores of the metal. The insulation power of the receptable is well maintained for a long time. The containers, of a spherical form, which serve for the transportation, have a very slender neck in order to lessen evaporation. This slender neck would make decanting difficult, as the air which must take the place of the outflowing liquid cannot come in at the same rate of the liquid coming out. Therefore the neck of the inner bottle B (Fig. 1) which does not touch the external wall A, has been elongated; when the bottle is tilted, the interior tube, long and with thin walls, is bent; the inner bottle touches the outer at D and E (Fig. 2); the insulation is interrupted; there is a warming up of the space, and the warmed up liquid—partly evaporized—creates an interior pressure, which drives the liquid through the thin neck. It is thus possible to pour out quickly and steadily.

The combustible material must be rich in carbon, and also porous, so as to come in intimate contact with the liquid oxygen. Several have been tried; a mixture of gasoline and infusorial earth (Kieselguhr), in proportion of 40 to 60; a dry wood pulp; finely pulverized cork; dried peat; lampblack. This latter showed its unqualified superiority over all other material.

Use of the Cartridges

By what is known as the Kowastsch method, the liquid oxygen is poured upon the lampblack in the bore-hole. A cylindrical cardboard cartridge is made of the same diameter as the hole (Fig. 3); this cartridge B contains the lampblack C, or other porous material rich in carbon. It is closed at both ends with cardboard or cork. Two small tubes A, of thin cardboard, pierce the stopper at the outer end. These tubes serve for the pouring of the oxygen, also for the ignition system (fuse or electric). The cartridge being thus made, a metal rod is inserted in each tube to prevent them being crushed, and the cartridge is deposited at the bottom of the hole. It is then packed with a wad of clay. The metal rods are then extracted and the liquid oxygen poured in through the larger tube by means of an elbow funnel. The gaseous air escapes by the shorter tube, and also the overflow of liquid oxygen when the cartridge is saturated completely. The cartridge is now ready for the firing. The explosion is comparable to that of dynamite.

The Marsit method allows of a more regular working; it is therefore more in use than the other. Here the cartridge is saturated before being introduced in the bore-hole. To do this the cartridges are immersed in a special vessel of cylindrical shape with double walls, filled with liquid oxygen (Fig. 4). The cartridges are left first exposed for a few minutes to the vapors above the liquid, to cool them off, then completely immersed for half an hour. The saturation is therefore complete. When the cartridge is saturated, it is taken out, and the ignition system attached as quickly as possible; it is then placed in the bore-hole and tamped, as shown in Fig. 5, and exploded.

The manipulation in this method is far simpler than in the first mentioned. The only inconvenience is the unavoidable delay between the taking out of the cartridge and the placing in the bore-hole. During the lapse of these few minutes a certain part of the oxygen of the cartridge evaporates. To lessen this loss, and to keep in the lampblack a sufficient excess of oxy-

gen, the walls of the cartridge are made watertight; they are of corrugated cardboard. Fig. 6 shows this cartridge, called the Messer cartridge, which is very much in use. This make-up explains the long duration of the immersion. But in this way the cartridges keep their strength for 8 to 10 minutes after they are taken out of the liquid oxygen.

There is no need of a detonator to explode these cartridges, and this is one of the advantages of the new method; all that is necessary is a small primer ignited by a fuse or by electricity.

Practical Results

The principal company manufacturing oxyliquit, the Sprengluft Gesellschaft, m. b. H., of Berlin, claims to have delivered each year an equivalent of 10,000 tons of nitric explosives. Even allowing for probable exaggeration, that shows how widely this product is used in Germany. Its greatest advantage over other explosives is that it almost entirely eliminates the danger of accidents. The cartridge itself is explosive for about 10 minutes only, between the time of its saturation and the time of its ignition. During this time the danger is not any greater than with any other explosives. The result is that in case of a miss it is only necessary to wait half an hour for the cartridge to become entirely harmless, and then one can uncover the bore-hole without any danger. What is more, all dangers inherent to transportation and storage of the explosive are entirely eliminated.

The method, however, has its inconveniences, the principal objection being that it is impossible to store liquid oxygen, necessitating the establishment of a liquefaction and rectifying plant at the place where it is used. Also there is need of very experienced hands for a quick charging of the bore-holes.

Theoretically the new explosive can claim superiority over others. In practice, however, it gives an explosion hardly equivalent to the most powerful explosives known, the common dynamite and the gelatine-dynamite.

Thawing Dynamite.

DYNAMITE is both combustible and subject to explosion from a heavy shock or concussion. Such being the case, it would not make safe kindling wood for the kitchen stove. Neither would a man drop it from a second-story window on the pavement any sooner than he would his watch or his eye glasses. As a rule, any ordinary heat that does not injure the human body is perfectly safe from the dynamite viewpoint. The low freezing dynamites are not affected by cold at a temperature above that at which water freezes, but will chill at lower temperatures.

When frozen it is more insensitive and may give trouble by failing to explode; hence it should be thawed before using. Several instances have been known where frozen dynamite has been laid on top of a hot stove or in the oven with disastrous results to the stove, and somewhat damaging effects on the unenlightened individual who attempted to do the thawing in this manner.

Probably the best method of thawing small quantities is to have two metal vessels, one fitting loosely into the other, or a specially constructed double compartment kettle. The outer vessel or compartment should be filled with warm water, while the dynamite is placed in the inner compartment, where it is dry, and allowed to thaw. The practice of placing the dynamite cartridges themselves directly in the warm water is questionable, for instances have occurred where some of the explosive ingredient has been leeched out.

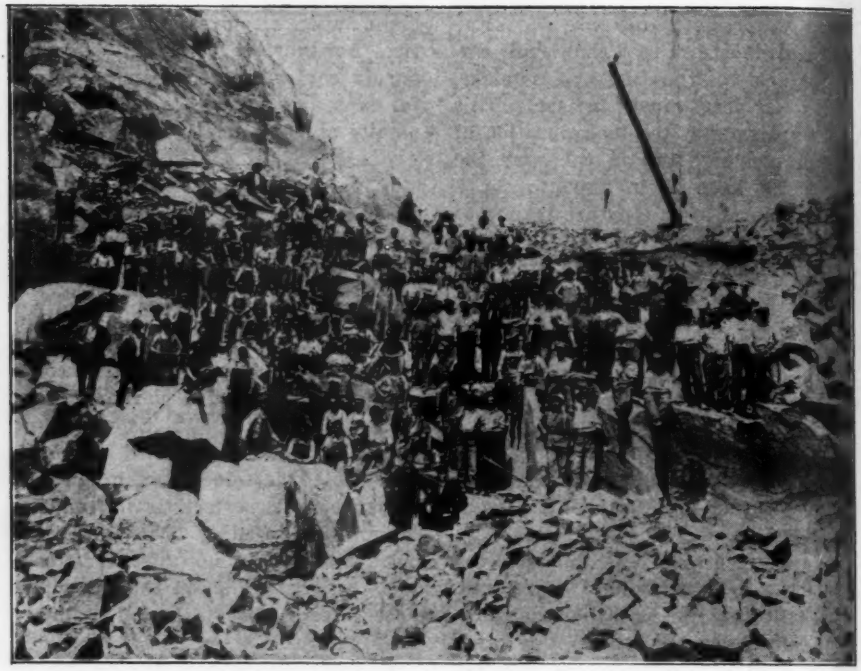


Fig. 1—View of extreme east end of Spring Lake Quarry of the Washara Granite Quarries Company.

Wisconsin Granite Operations

Waushara Company's Quarries at Spring Lake Turn Out an Excellent Product

GRANITE blocks are the principal but by no means the only product of the Waushara Granite Quarries Company, for they turn out also an excellent and highly prized quality of monumental stock and hundreds of cars of crushed granite which find at all times a ready market. The company was organized in 1903 with offices in Chicago. Its most interesting property is the quarry at Spring Lake, Wis. This comprises 46 acres, and the opening now is 460 by 365 feet with a depth of 50 feet. A very good idea of the character and method of operation can be obtained from the illustrations.

The first photograph gives a view of the extreme east end. Normally about five hundred men are employed here and this picture shows quite a group of them. The view also gives an excellent showing of the quarry formation. In handling the stone a modified gravity system is generally employed. The bench being so high, the stone is dumped direct into railroad cars.

In the second illustration are shown granite blocks ready for loading. Almost the entire output of the quarry is used by the city of Chicago and the Chicago Surface Lines. Another important contract is with the Ready &

Fig. 2—Granite blocks, ready for loading.

Callaghan Co. to supply all the granite blocks required for paving contiguous to and within the big central warehouse establishment of the U. S. Quartermaster Department on Thirty-ninth street from Ashland Avenue to Western Avenue and along the Drainage Canal.

The paving blocks from the Waushara quarries are highly prized for their superior wearing quality, being much harder than Vermont or other New England granite. Its fine rich color also adapts it splendidly for dimension stock and for monumental purposes. The company produces about 200 cars of monumental stock each year, and this is all contracted for delivery to two concerns—the Marathon Granite Co. of Wausau and the Pike River Granite Co. of Marinette, Wis.

The crusher house, shown in Fig. 4, is equipped with three McCully crushers, one No. 6 and two No. 3, operated by three Allis-Chalmers motors of 225, 125 and 25 hp. respectively. The quarry equipment includes also, besides dump cars of the company's own design, six American Hoist & Derrick Co. derricks and six hoisting engines, all electrically operated except some of the derricks, and one Sullivan compressor class W B-2, operated by a 350-hp. Allis-Chalmers scintillating motor.

Thomas P. Flynn, president of the Waushara Granite Quarries Company, is one of the most popular of the stone men of Chicago and the Middle West and known internationally also for his energetic work in connection with K. of C. and other patriotic activities. He is entitled to three bright stars in his service flag, having three sons in Uncle Sam's service. Following is an extract from a recent letter from Sergeant Raymond D. Flynn, who at this writing is still in France. It shows that our boys over there will be able to give us some pointers on roads and roadmaking when they come back to us:

"Granite blocks sure predominate for pavements over here. While in England, all our marching was done on granite, and two-thirds of the pave-

Fig. 3—Dimension and monumental stock.

Fig. 4—Crusher house. Three McCully crushers, one No. 6 and two No. 3 are here installed.

ments in the larger cities are granite block. In England, all the approaches to railroad stations, the yards, etc., are paved with the Durax block, a little larger than those we laid at Twenty-sixth and Western Avenue, while most of their main streets are paved with the larger block. They differ entirely from the Chicago specifications. In some cases they are almost 6 to 7 in. square and they do not give nearly as even a surface as the Chicago block. Of course all my observations were made at rout step or from a car window."

Standard Sand for Plastering.

Norman G. Hough, chief of the Construction Bureau of the Lime Association, has been charged by Committee C-7 on Lime of the American Society for Testing Materials with recommending a standard sand for plastering purposes, and he is devoting considerable study to the matter at this time. The first step is to analyze sand generally for plastering purposes in the larger markets. Requests for 5-lb. samples have been made from New York City, Philadelphia, Wilmington, Atlanta, Cleveland, Chicago, Indianapolis, Cincinnati, Toledo, Detroit, St. Louis and Kansas City producers.

Lime Producton in the United States

COMPLETE statistics of lime burned and sold in the United States in 1917, as reported by the U. S. Geological Survey, and just published, show a total of 3,786,364 short tons, valued at $23,807,877—a decreased of 7 per cent in quantity but an increase of 28.6 per cent in value over the figures of 1916. In 1917 only 597 plants were in operation, against 778 in 1916. The average price per ton, which for a number of years has been within a few cents of $4, rose to $6.29 in 1917.

The following table shows the output of all States marketing more than 50,000 short tons:

Lime Produced in 1917

State.	Total Lime Tons	Value
Pennsylvania	936,209	$ 5,900,056
Ohio	479,856	2,975,466
Virginia	307,195	1,820,446
West Virginia	245,569	1,268,343
Missouri	234,936	1,435,914
Wisconsin	169,650	1,037,578
Michigan	135,920	892,682
Massachusetts	134,937	916,569
Maryland	133,087	694,576
Maine	124,199	950,811
Indiana	118,530	646,555
New York	108,788	892,855
Tennessee	101,836	504,599
Illinois	83,409	501,320
California	78,401	597,528
Alabama	66,744	383,211
Connecticut	64,389	492,678
Texas	52,742	361,308
Other States	209,967	1,535,382
	3,786,364	$23,807,877

The quantity of hydrated lime manufactured and sold in 1917 was 709,167 short tons, valued at $4,643,004, in comparison with 717,382 tons in 1916, valued at $3,626,998. The average price per ton of hydrated lime was $6.54 in 1917, an increase of $1.48 over 1916. The hydrated lime sold for use in buildings amounted to 402,223 tons, and that sold for use in agriculture to 177,815 tons. There were 90 hydrating plants in operation.

Lime Sold in 1917, in Short Tons

	Total Lime	Hydrated Lime
Building	1,313,597	402,223
Fluxing	209,976	.....
Chemical works	772,787	52,255
Paper mills	355,768	6,728
Sugar factories	47,546	5,227
Tanneries	66,629	13,979
Glass factories	60,624	3,277
Agriculture	488,297	177,851
Dealers and others.	471,244	47,653
	3,786,468	709,157

There was a decrease in the quantity used for building and for agriculture, and an increase in that used for fluxing, chemical work, paper mills, and tanneries.

Coöperation means success. Now that the war is over let us all get together and make the joint meeting in Chicago of the Highway Industries Association and the American Association of State Highway officials a momentous record for highway development.

Modern Management Applied to Quarrying

By Daniel J. Hauer

This is the introductory article of a series on this important and vital subject. It shows the need of modern management in quarry operations and describes the attitude of some quarrymen. The outlines of modern management are also given. Succeeding articles will deal with details.

RAPID strides have been made during the past decade, not only in quarry machinery but also in the methods of quarrying. Here and there scattered over the country can be found model quarries, viewed from the point of equipment, and in these modern methods are bound to result from installing modern machinery. On the other hand there are many quarries everywhere in which methods and equipment are both behind the times—the result either of lack of knowledge of what others are doing or of mistaken methods. The furnishing of needed knowledge, the gathering of information as to plants and the correction of mistakes constitute the work of experts on modern management of quarries.

It is quite surprising to note the attitude of many quarrymen as to suggested improvements which would increase their profits and put extra money into their bank accounts. Many seem to resent these suggestions as reflections on their business ability or knowledge of quarrying. One New England man said: "You mean to tell me that you or any man can tell me and my men better ways of quarrying and crushing stone, or even of blasting. It is impossible, and I will not listen to you."

Another said: "I have not time to talk of modern methods, I am too busy in getting out stone. I won't have time until I die."

These men must not have believed in modern management to have answered in this manner, yet it would have cost them nothing to learn something of what was possible.

Why They Hesitate

The treasurer of one large quarry company said: "We are following the exact outline you show, in keeping our accounts, so that we are certainly up to date, and can see no reason for making any change." This in spite of the fact that many methods in the quarry were obsolete and expensive. Two items alone showed, from a study made over a period of several days, a possible daily saving of more than thirty dollars, with an increased output that could not be accurately estimated. Why should a man turn down the opportunity of saving thirty dollars or more per day?

One quarry owner thought it might be possible to improve on his methods, but he hesitated, and, like the man from Missouri, wished to be shown; yet the first suggestion seemed to rouse his ire, and he jumped to the conclusion that if one thing was doubtful, then all must be.

In another section of the country a quarryman insisted that no man could know his quarry like himself, and that the fact that it was his own

money that was involved certainly meant that no outsider could beat him in operating his plant. This same man would say to his foreman: "Obey orders if you break owners."

A "Friend's" Advice

One operator said: "I am well satisfied with my quarry development and the methods used, the reason being that I invited a friend to visit the quarry during the past year. He is the president of the largest quarry in this section of the country and he was so pleased with this quarry that he told me it could not be improved." This recalls the story of a celebrated New York attorney who walked each day after office hours in the Battery. A merchant friend, thinking he could get some free advice on a legal matter, made it convenient to meet this lawyer in his walk, as though by chance. During the conversation that followed the merchant stated his case and asked the attorney's advice, who promptly said: "Bring a suit and you will win."

Acting upon this advice the merchant engaged a cheaper attorney, brought suit and lost. Upon a favorable opportunity he told the eminent attorney of the result, as he again walked with him in the Battery, with rather an injured tone in his voice. The attorney listened, then asked: "Did I advise you to bring suit?" "Yes," was the reply. "Was my advice given in my office or here in the Battery?" "Right here, where we are," replied the merchant. "Well," said the attorney, "between you and me I would say my Battery opinions are not worth a d——n."

This is always the case with free advice and opinions. A visitor is hardly going to tell a friend he is not operating his quarry properly. One must pay for advice and assistance in making extra money. Even good advice given free is seldom appreciated or followed.

An official of a large quarry company wrote to an expert sending him the company's methods of keeping accounts, cost-keeping and the distribution of accounts, asking for an opinion on the method outlined. The expert spent an entire day going over the matter and writing at length to the quarry official. The opinion evidently was not pleasing, for the quarry company never acknowledged the letter. Such a report could have been sold by the expert.

One quarry owner asked an expert to inspect his quarry, and spent the time telling the expert of the wonderful results obtained, when any stranger could see that the crusher was idle half the time. The expert never had an opportunity to express his opinion, for the owner was too well satisfied.

Many more such examples could be cited, but enough has been written to show that many quarrymen talk of improved methods, modern management and efficiency, yet are more concerned in following their own ideas and duplicating and repeating their mistakes.

"Efficiency Will"

This would seem to be preposterous, but it resolves itself into one condition of mind. The quarryman may talk of efficiency and modern management, he may think he wants to be up-to-date in his quarry, but when he makes such excuses as recorded it is evident that he has not "efficiency will."

This term is defined as follows: "Efficiency is, first of all, or needs first of all for successful operation, a certain state of mind. This state of mind involves, first, the belief that efficiency, beyond that already attained, is certainly possible, attainable and vitally valuable; second, the understanding that efficiency, like any other result of value, is to be attained and maintained by study, records, or-

ganization and inspection, demanding maintenance expense; and thirdly, an active determination of the executive organization to coöperate enthusiastically and continually. This state of mind may be called 'efficiency will.'"

Possessing it, modern management will be invoked and applied and the results attained will be surprising.

Modern management can be applied in two ways. First, to the basic principle of operating the quarry, covering all the operations and the details. Secondly, to correcting mistakes in the various details. In starting a new quarry the first method is the proper one, but in an old quarry this may not be possible, as it may involve rebuilding the plant and the purchase of new machinery. For that reason it may be necessary to use the second method and first correct mistakes as to details, thus effecting such savings as to allow other changes to be made from them. This means to make changes slowly, but it is the only way in many cases.

Present-day Conditions

Today the quarry business is hardly normal. Some quarries cannot operate, while others can get cars from the government and sell at prices much higher than formerly. Prior to the war most quarries labored under the disadvantage of costs increasing over a term of years, while the selling price for crushed stone remained about the same. Thus each year quarry profits were decreasing, really demanding that some economies be effected in the operation. These conditions may be repeated after the war. Under such circumstances the need for modern management is emphasized.

Let us illustrate what can be done. First we must go to the quarry. The ledge should be laid out so that the rock can easily be measured. Then the blasting must be done to advantage so as to get the greatest tonnage to the foot of hole drilled and pound of explosive used. The quarry plant must be selected and installed with the view of a low investment, yet with the greatest efficiency of operation. Then comes the transportation to the crusher plant.

This plant must not only be selected from adequate knowledge of machinery on the market, but it must be arranged and installed so as to save power, labor and other items in operation. These things go on through the entire business, the various details being too manifold to enumerate.

In more general terms, modern management embraces high ideals, common sense, competent counsel, the planning, scheduling, and standardizing of conditions and operations, the culling out of obsolete business ideas, the substitution of contract work for day labor, the paying of bonuses, the discarding of unprofitable parts of a business, the elimination of waste of both material and labor, the selection of plant and men, the economical operation of machines, the handling of products and intensified selling of them, and a hundred other details.

Correct principles applied and lived up to will mean to put quarrying upon an entirely different basis. Instead of chance governing the business it will become a more exact science, and money will be made both in dull and good seasons.

Going with the field management must be modern systems of accounting and cost-keeping. These must be the basis of much that is done, and the gathering of costs must not be in a scrapbook manner but along a well thought out system. The costs should be analyzed each day, for modern management must be founded upon accurate and analyzed costs.

Maintenance of Highways

By Edward Barrett,
State Geologist of Indiana.

THE proper construction of a road comprises the following elements, viz.: proper materials, width, thickness, crown, berm, curves, gradient and drainage. The proper relation and coördination of these elements spells good roads.

Granted that these elements are all present in a completed road, what is the next most important concern of the community after the completed road has been thrown open to traffic? We answer without hesitation, maintenance.

As there are important elements in road construction, so there are also important elements in road maintenance. These may be classified as follows: dragging, rolling, filling, culverts, bridges.

The moment a completed road is opened to traffic, that moment begins its destruction, and this will continue until the road is ruined, unless proper maintenance is kept up.

If a "penny-wise, pound-foolish" policy is adopted—particularly as regards road repairs, for every dollar saved ten will have to be spent to make up for the destruction that will go on and which will increase alarmingly.

In caring for highways—used now ten times as much as they were a year ago—nothing fits the case so well as the old saw: "A stitch in time saves nine."

Unless liberal road repairs are permitted all over the country, many highways will continue each year to be so impaired by the normal wear and tear of the summer and fall that they will be absolutely of no avail when winter comes.

Under the present system in Indiana there is an absolute check upon the money spent for road repairs. It is possible for any person to consult the records in the highway superintendent's office and see just where the money has gone. It also insures a personal supervision over the repair work of county highways, and serves to adjust the distribution of funds in the different districts, thus avoiding the spending of the taxpayers' money with incompetency and in a careless way.

It seems certain that the next session of the legislature will create a state highway department, and through the office of highway superintendent a complete coöperation between the state department and the counties can be formed. Each county has its own particular highway problems to work out, and the type of road that would be successful in one county would not necessarily be entirely successful in another county.

Edwin Duffy, commissioner of the New York State Highway Commission, which is recognized as having the best organized and most efficient state highway department in the country, said in a recent address that the highway superintendent was the most important civil officer in the county in the present day of road building, and the success of the New York department was due to a large extent to the hearty coöperation received from the superintendents.

The custom of changing highway superintendents every two years has been exceedingly detrimental to the highway work of the counties. The office of highway superintendent should be removed from politics.

Pit and Quarry

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Construction and Reconstruction

LAST month marked the end of the most terrific orgy of destruction the world has ever seen. This month we already see the beginning of an unprecedented era of construction and reconstruction. In the United States all delayed construction programs are already being resumed — abroad a tremendous program of repair and reconstruction only awaits the termination of the peace conference.

It is the undivided opinion of those who ought to know—men like Bernard M. Baruch, who have been shaping the national policy, that all producers of raw materials will be compelled to start full speed ahead to supply the demands which will soon be made on them. In connection with their reasons for this belief, the President's advisers have said that the United States has been practically paying for the war as it went along. This pay-as-you-go policy has given it a commanding position in world finance that is certain to be reflected when the peace conference meets.

There looms ahead of the great industries represented by PIT AND QUARRY, therefore, the brightest possible prospect of peaceful prosperity. But those who would reap the full fruition of these good times coming must be prepared for it. Now is the time to get in perfect order every pit, every quarry, every plant, for "full speed ahead."

Great Highway Convention

EVERY reader of PIT AND QUARRY should coöperate with the Highway Industries Association and the American Association of Highway Officials in emphasizing the importance and significance of the convention called jointly by these two organizations for December 11 and 12 at the Congress Hotel, Chicago.

Every citizen of the United States who is interested in public welfare to the extent of protecting the investment already made in highways and to see their future development along definite, aggressive and sensible lines should be present and personally participate in the deliberations.

Federal Food Commissioner Herbert C. Hoover recently urged the importance of increased efficiency in highway transportation because, first, under present conditions 50 per cent of the perishables produced in the United States are wasted largely through ineffective means in getting them to market; secondly, because in his opinion there is likely to be a more serious food shortage now than there ever was during the war.

Secretary of Commerce Redfield urges, in justice to all the people of the United States, the development of highways and all other elements of

transportation to their highest point of efficiency consistent with the economic demands of the country.

Public sentiment, as well as "the powers that be," are at one as regards the need of more and better roads. The iron is hot. Now is the time to strike. If every one directly interested will do his share to help the activities already so well begun, there will soon ensue an era of road-building unexampled in history.

The amount of traffic over the nation's highways is increasing at a much greater rate than highway construction. It will be necessary, to properly provide for this traffic, to largely increase the amount of road construction. At present there are at least 450,000 miles of roads that should be surfaced that have not been improved and at the rate that construction has been progressing it will take thirty years to build these roads. The economical development of traffic demands that at least one-third of this mileage should be built quickly and plans should be formulated and worked out at the Chicago Convention whereby the nation, state, county and local sub-divisions can immediately undertake this work and push it to completion.

Prosperity Figures

ALL restrictions on building construction have been revoked or modified. That most of our big cities are underbuilt is known to all.

Resumption has been ordered of work on United States public buildings. Public improvements of all kinds which have been withheld on account of the war will now go forward. In Chicago alone this releases at once over $20,000,000 of public work.

All restrictions on the manufacture and use of agricultural lime and limestone have been removed. Lime will be used as never before in agriculture.

Highway construction can now be interfered with only by the weather. The war has been the best possible educator on the need of good roads. Illinois has voted a bond issue of $60,000,000 by a vote of four to one. Pennsylvania has voted, by a majority of 180,000, an issue of $50,000,000. In each case this means actual expenditure of double or triple the amounts named, as county and township aid. Uncle Sam will spend at least $100,000,000 on military highways. There is no doubt that pending legislation to this effect will pass almost unanimously.

All this is only the beginning of a message of great joy which will be continued in the January, 1919, issue of PIT AND QUARRY.

Illinois and Pennsylvania, both by overwhelming majorities, have approved great highway bond issue proposals. Pennsylvania's was for $50,000,000 and Illinois' for $60,000,000. These are the first guns in the post-war highway drive. Thus do the people of two great commonwealths record their views on highway improvement. They consider good highways essential to their welfare and are glad to pay the bill.

Living Memorials.

Credit is given to Bucyrus, Ohio, for originating and carrying into effect a most appropriate plan for commemorating the soldier dead of the community who have made the supreme sacrifice. The Employers' Association of Bucyrus, composed of the manufacturers of the city, has passed resolutions to plant memorial elm trees along the Lincoln Highway, each tree to be a commemorative of a Bucyrus or Crawford County boy whose life has been given in the service of his country.

WILL YOU kindly continue to send PIT AND QUARRY. I find the information contained therein of the greatest value and interest.—United Fuel & Supply Co., Detroit, Mich.

Labor Saving in Limestone Quarrying

By Oliver Bowles

SECOND AND CONCLUDING INSTALLMENT

WHILE the actual processes of loading and tamping drill holes afford no means of appreciably conserving labor, blasting efficiency has a direct bearing on the labor required in subsequent operations. Improper arrangement of drill holes, imperfect balancing of charges, or the use of too powerful or too weak an explosive may result in a very inefficient blast, and, as a consequence, rock loading may be greatly hampered. There is, in fact, no other department of the quarry in which inexperience or lack of judgment may in a brief period occasion more disastrous consequences. This is particularly the case where many large blasts are fired simultaneously in deep churn-drill holes, for the mass of rock thrown down may occupy the rock loaders for a period of several weeks or even months. If the rock is imperfectly shattered or improperly thrown down, excessive secondary blasting may be required, and the process of loading may be slow and difficult throughout the entire period. On this account it is false economy, both of money and labor, to employ cheap and inexperienced men as blasting foremen.

Blasting Efficiency

If, on the other hand, blasting is done by an experienced man of good judgment, subsequent operations may be greatly simplified. If the rock is thoroughly shattered, little labor is required for secondary blasting, and if the rock fragments are thrown down in a way that permits easy handling, loading operations may be performed rapidly and with minimum effort. A realization of these facts has led some operators to engage the services of blasting experts who are not permanent members of any quarry organization, but who travel about from quarry to quarry as their services are desired. The expert, in accordance with his judgment, developed by long experience, supervises the arrangement and spacing of drill holes, selects the explosive, proportions the charge for each hole, carefully inspects or tests all connections and fires the charge. The results usually obtained amply justify the employment of such experts.

Secondary Blasting

If the rock ledge is thoroughly shattered by the primary blast, very little secondary blasting may be required. If, however, the primary shot merely fractures the ledge, with the production of numerous large, solid blocks, much secondary blasting may be needed to reduce the blocks to convenient size. It is evident, therefore, that the extent of secondary blasting is in a large measure dependent upon the efficiency of primary blasting.

Rock that is schistose in character is usually shattered effectively by the primary blast. Where schistosity is only moderately developed the rock has a tendency to split out in long, thin slabs. This is known among quarrymen as "slab cleavage." In most limestone quarries, however, the rock is massive and tends to break into more or less cubical blocks. Such rock is said to possess "cubical cleavage." Where steam-shovel loading is employed, rock having slab cleavage requires less secondary blasting than that with cubical cleavage, for a rock crusher will accommodate a larger mass in the form of a long, thin slab than it will in cubical form. Schistosity, therefore, tends to reduce the necessity for secondary blasting. In some of the schistose cement-rock deposits of the Lehigh District of Pennsylvania, the rock is so thoroughly shattered by the primary blast that little or no secondary blasting is required. Few quarries for the production of blast-furnace flux are of this type, as the rock is usually massive in character.

Where vertical open seams are spaced 6 to 8 feet apart there is a tendency for the primary blast to push out large solid masses that require excessive secondary blasting. With such an unfavorable condition at least one of the blast holes for the primary shot should be located in each rock

mass between seams, for thereby each mass is shattered. On the other hand any large mass that is not penetrated by a drill hole is simply pushed out. It is evident, therefore, that the amount of secondary blasting required in connection with unsound rock ledges is largely dependent on the skill employed in primary blasting.

The toughness of the rock is also an important factor in this connection. Tough rock with few seams or bed planes tends to break into large, cubical masses requiring maximum secondary blasting. The proper method of dealing with such rock can usually be determined only by experience. By varying the diameter, spacing and burden of primary drill holes, or by varying the amount or grade of the explosive the blast foreman may be able to arrive at a combination that will promote effective shattering.

If the rock is loaded by hand the fragments must be small enough for one man to handle, or must at least be small enough to be easily sledged to one-man size. If many large blocks result from the primary blast, much secondary blasting may, therefore, be necessary where hand loading is employed.

Where a steam shovel is used for rock-loading, especially if the shovel is equipped with a dipper of 3- to 4-yard capacity, large rock masses may be loaded and secondary blasting may be reduced to a minimum.

Labor-Saving in Rock-Loading

Rock-loading is an important department in the quarrying of limestone; in fact, in many quarries more labor is required in this than in any other branch of the work. In some localities the cost of loading is one-third to one-half of the total cost of quarrying. In this branch, therefore, special efforts should be made to conserve labor.

There are in common use two distinct methods of loading. In some quarries the rock is shattered by blasting into fragments that one man can handle, or to sizes that can be readily reduced to one-man size by sledging. These fragments are then loaded into cars by hand. In many quarries this method has been superseded by the use of power shovels operated by steam, electricity or compressed air. The advantages and disadvantages of these two methods have been discussed in a former publication. For quarrying fluxing limestone the most obvious advantage in the hand-loading method is the ability of the hand loader to select the desirable and to reject the inferior material. Thus, when hand-loaded, the rock may be hand-picked. Where steam shovels are employed, such selection is not possible; if siliceous material is shot down with the rock, it must be loaded with the rock and separated subsequently by screening or washing.

The rock tonnage loaded by hand per man per day varies greatly in different localities. Thus in one of the largest fluxing quarries of the Birmingham district of Alabama the loaders average about 18 tons per man per day, in a Western Pennsylvania quarry they average only 15 tons, and in two Eastern Pennsylvania quarries they average 25 and 30 tons, respectively. An average of several quarries, some for the production of limestone for Portland cement and some for the production of limestone flux, is 20 tons per man per day. Thus, a quarry producing 1,000 tons of rock per day requires an average of about 50 loaders.

Steam-Shovel Work

The labor requirement for steam-shovel work is variable, depending on the size of the shovel employed and on the conditions under which it operates. In one Eastern Pennsylvania quarry a small tractor shovel with a ¾-yard dipper requires a maximum of 3 men and loads a maximum of 400 tons a day. It is claimed by the quarry foreman that it can accomplish as much work as 12 hand loaders, though in ordinary practice it does the work of 7 or 8. A shovel of this type, therefore, saves the labor of 4 or 5 men for an output of 250 to 300 tons per day. In another Pennsylvania quarry it is claimed that two steam shovels, employing 10 men in all, load as much rock as 45 men by hand methods.

In one Western New Jersey quarry a steam shovel employing 3 shovel men and 4 pit men loads 1,200 tons per day, or an average of 171 tons per man per day. In one Eastern Pennsylvania quarry two steam shovels requiring the services of a total of 16 men load 1,000 tons a day, or an average of only 63 tons per man per day. Figures obtained at various quarries in widely separated localities indicate that an

average of about 128 tons of rock per man per day is loaded by the use of steam shovels.

The above figures indicate that a material saving of labor may be accomplished by the use of steam-shovels. Hand-loading methods are still employed, however, in many places. While various objections may be raised to the employment of power shovels, the saving of labor that may be effected by their use should demand careful consideration. While, on account of war conditions, steam-shovel equipment has increased greatly in price, the increased cost is not out of proportion to the increased wages for laborers.

Labor-Saving in Transportation

A simple and direct system of transportation is an important factor in designing a new quarry plant. Ease of transportation depends greatly on the situation of the rock ledge. If close to transportation lines and at a high level, conditions are most favorable. A shelf quarry with its floor at a higher level than the crusher or other plant operated in connection with the quarry represents the most favorable condition, for thus transportation may be accomplished by a single operation. Whatever the conditions may be, a single efficient system is to be desired, and, if this is not possible, the fewest possible combinations of different systems of transportation should be employed. An instance has been observed where transportation of rock from the quarry face to the crusher involved the use of a horse, a cable incline and a locomotive. Such a complication of systems involves an excessive amount of labor.

Utilization of Gravity

Gravity, when properly utilized, is an effective substitute for power, and it should therefore be utilized for transportation purposes whenever possible. A previous report issued by the Bureau of Mines cites the use of the gravity system by a New Jersey quarry, its utilization being so advantageous that, for an average production of 1,200 tons of rock per day, transportation within the quarry requires the services of one man only.

At one New York quarry the rock is hauled to the crusher in cars by locomotives, all subsequent movements being assisted greatly by gravity. The plant is on a hillside, the crusher, screens, storage bin and railway line for final haulage being at successively lower levels. Accordingly, the movement of the rock is automatic and requires little or no supervision.

The substitution of the force of gravity for man-power offers many attractive possibilities when viewed in the light of present labor shortage.

Transportation Equipment

An adequate supply of rolling stock is essential as regards labor economy. A shortage of cars or of locomotives is sure to result in frequent temporary delays with consequent loss in labor efficiency.

Cars should be strong enough to withstand the hard usage required of them in the process of loading and unloading. Car breakage may tie up transportation, and any prolonged delay may retard operations in other departments, such as loading and crushing. Furthermore, frequent repairs reduce the available car supply and increase the labor requirement in the repair shops. A certain amount of repair work is inevitable, but the use of strong cars tends to reduce the necessary repair work.

Certain types of equipment tend to conserve labor. By means of a central-control, three-rail electric system now employed in certain large limestone quarries, several thousand tons of rock may be delivered from the steam shovel to the crusher daily with the employment of only two or three men. Aerial tramways and various types of cableways are for the most part automatic and thus require little labor.

Trackage

Except where cable cars are employed, heavy grades should be eliminated as far as possible. Car haulage on heavy grades is wasteful of time and power. The maintenance of a firm roadbed and uniform gauge also tend to permit rapid and safe movement of trains. The trackage system connected with any quarry should be planned to cover the most convenient and direct routes.

In connection with both trackage and rolling stock, it is imperative that all repair work receive immediate and careful attention. It is a false economy of labor to reduce the normal number of repair men; for with defective equipment there is constant danger of accident and delay.

Rehandling of Material

A fruitful source of wasted effort is unnecessary rehandling of material. Rock is commonly unloaded and reloaded unnecessarily, or dumped in places that require excessive labor for its subsequent removal. An instance has been observed where a small percentage of a type of rock necessary for plant operation is brought from a distance and mixed with the main supply of rock quarried at the plant. Such rock is carried in hopper-bottom cars, dumped to the bottom of a 40-foot quarry pit, reloaded by hand into carts, hauled by mules to the foot of an incline, and lifted by cable to the crusher. Such excessive rehandling may be due to lack of equipment or to faulty plant design. In time of labor shortage it is imperative that radical changes be made to remedy such faults.

Crushing

The size of the crusher employed has a direct bearing on the labor requirement, not only in the actual crushing operation, but also in other branches of quarry work. A prolific source of wasted labor is the employment of a small crusher for rock loaded with a powerful steam-shovel. The attempt is commonly made to substitute steam shovels for hand-loading methods and at the same time to retain the small crushers usually employed for reducing rock loaded by hand. Such a combination of a massive loading apparatus with a small crusher has a two-fold effect on the labor requirement.

In the first place, much labor may be required to force the large rock fragments into the crusher. An instance has been noted where a No. 9 gyratory crusher is employed to handle rock loaded with a No. 60 Marion steam shovel. Four men were employed to force the rock fragments into the crusher, and the total output averaged only 400 tons per day. Obviously, the rock could be handled with greater facility and with fewer movements by the employment of a crusher having a wide mouth.

A second result of the combination mentioned, indicating that it entails an excessive labor requirement, relates to the process of handling rock in the quarry. Were a large crusher used, blocks of the full capacity of the steam shovel dipper could be loaded. If, however, the crusher has a narrow opening, all large blocks of stone must be reduced to convenient size. Large blocks must, therefore, be shattered ahead of the steam shovel or be set aside and subsequently broken up by blasting. It is evident that such processes demand additional labor.

Opinion is divided as to the best type of crusher to be employed. Gyratory crushers are popular and are in common use. Single or double roll crushers have the advantage of wide mouths that are not readily obstructed by blocks of stone. A jaw crusher fed by a traveling apron is an effective labor-saver.

Removal of Jammed Blocks

The jamming of blocks of stone in a crusher mouth is a common occurrence. If adequate facilities for the removal of such blocks are not provided, much time and labor may be wasted. The attempt to loosen jammed blocks of stone by using a bar or a sledge may so delay the crusher that other related operations, particularly transportation, are temporarily suspended. It is wise, therefore, to equip rock-crushing plants with mechanical devices for such emergencies. The use of rope tackle or a pneumatic hoist is common, and either renders efficient service.

Safety Measures

At all times operators of quarries have before them the plain duty of taking active measures to provide for the safety and health of their employees. The operator is responsible for the inspection of equipment and for whatever repair is necessary to keep it in safe condition. It is his duty also to establish wise safety rules and to insist upon their rigid enforcement. Provision should be made for proper sanitation, and for all other matters pertaining to the health of employees, and to the proper care of those that may be suffering from illness or accident, in order that they may be speedily restored to active service.

But any number of safety measures carefully planned by quarry operators will not free the employee of his share in the responsibility. The employment of dangerous methods, the failure to report observed dangers, and the frequent temptation to "take a chance" are fruitful sources of accident.

ASSOCIATION ACTIVITIES

Limestone Conference at Buffalo.

A representative attendance marked the limestone conference which was held at the Lafayette Hotel, Buffalo, N. Y., November 12. Professor Fippin of Cornell University presided, and the morning session was taken up in considering the arguments advanced by manufacturers against rules requiring the farmer to fill out a certificate before validating his orders for limestone. The state directors of extension felt, however, the necessity of taking some action relative to the modified ruling in circular No. 9 of the Priorities Division of the War Industries Board, and the meeting was adjourned at 12:30 p. m. in order to give their committee an opportunity to present their requirements at 2:30 p. m.

At luncheon the conferees were the guests of the Michigan Limestone and Chemical Co. At 2:30 the extension committee reported with a recommendation that the manufacturers on and after November 15 be required to fill out blank forms in duplicate showing the amount of burnt lime, ground lime and ground limestone, and to whom and where shipped, not later than the 10th of the following month. One copy of this report will go to the state director, the other to the county agent of the county in which these materials are shipped. This will give the state directors and county agents valuable data for the benefit of all concerned. At the present time this rule only applies to the States of Ohio, Pennsylvania and New York.

The manufacturers at this meeting urged uniformity of regulations all over the United States, and Professor Fippin was requested to send a circular letter to all other state directors of extension, advising them of the action taken at this meeting and expressing the hope that they would likewise see fit to adopt the same form of regulation.

The attendance included the following:

Clyde Calvin, Bessemer Limestone Company, Youngstown, O.; J. C. King, Carbon Limestone Company, Youngstown, O., President of the National Agricultural Limestone Association; L. E. Leist, Kelley Island Lime and Transport Co., Cleveland, O.; Wm. M. Farnham, Grange Bank Bldg., Smethport, Pa.; E. B. Entwisle, Palmer Lime and Cement Co., 103 Park Avenue, New York City; C. B. Nicholson, American Lime and Stone Co., Tyrone, Pa.; Mr. Becker, Becker Limestone Company, Lincoln Park, N. Y.; Mr. Cole, Cole Limestone Company, New York City; Prof. E. O. Fippin, Cornell University, Ithaca, N. Y.; Prof. C. E. Baer, Ohio State University, Columbus, O.; Henry M. Camp, National Lime Manufacturers' Association, Washington, D. C.; Carl Hall, G. W. Johnson Limestone Company, New Castle, Pa.; M. E. Reeder, Chippewa Lime Company, Muncy, Pa.; Prof. M. S. McDowell, Penna. State College, College Station, Pa.; Chas. C. Ward, Michigan Limestone and Chemical Co., Buffalo, N. Y.; F. J. Streeter, Michigan Limestone and Chemical Co., Buffalo, N. Y.; C. F. McNair, Langdon Bros., Elmira, N. Y.; Mr. Hyman, Empire Limestone Company, Buffalo, N. Y.; Clark S. Wheeler, director of agricultural extension, O. S. U., Columbus, O.; H. H. Hodgkins, Gouverneur Limestone Company, Gouverneur, N. Y.; G. J. Wilder, secretary, National Agricultural Limestone Association, Columbus, O.

Southeastern Limestone Men Meet.

Problems of distribution formed the principal topic of discussion at a meeting of the Southwestern Limestone Association in the Chamber of Commerce, Knoxville, Tenn., on November 8. Part of the morning was spent in visiting the Tennessee Experimental Station, where Prof. MacIntire is conducting extended experiments in soil treatment. In the afternoon the party was

driven to Mascott, Tenn., to inspect the operations of the American Ballast Co., who produce agricultural limestone on a large scale and who also operate a farm in connection with their plant. Among those present were:

E. S. Mather, Buquo Lime Company, Columbia, S. C.; Geo. E. Oldham, American Ballast Company, Knoxville, Tenn.; D. T. Argo, Empire Cement and Limestone Co., Atlanta, Ga.; J. C. McAmis, specialist in agronomy, extension division, University of Tennessee; W. H. MacIntire, Ph. D., soil chemist, University of Tennessee Agricultural Experiment Station; L. J. Backus, Ladd Lime and Stone Co., Atlanta, Ga.; Thos. McCroskey, manager, American Ballast Company, Knoxville, Tenn.; J. C. King, sales manager, Carbon Limestone Company, Youngstown, O.; G. J. Wilder, secretary, National Agricultural Limestone Association, Columbus, O.

Agricultural Limestone in Indiana.

A number of producers of agricultural limestone in Indiana met in Indianapolis recently to discuss the possibilities of forming an association cooperating upon a publicity program. It developed, however, that there were wide differences, mainly affecting fineness of the product, and these prevented immediate action. Many plants are selling their screenings at a low price for agricultural purposes, while others believe that a finer ground product, although more expensive, is more desirable. The agricultural limestone business in Indiana has not been of satisfactory dimensions, and this condition is ascribed to the fact that the benefits of the material have not properly been put before the attention of the farmers.

In Ohio, and especially in the eastern part, the stone is reground to a fineness passing through a 100-mesh screen. Because of the remarkable work of the National Agricultural Limestone Association, with headquarters at Columbus, G. J. Wilder manager, agricultural experiment stations, farm publications, county and state fairs and many other mediums have familiarized farmers with the results of land improvement tests, so that at the present time considerable knowledge has been gained by the farmers in the use of the fine-ground product. In Ohio the annual consumption is about 200,000 tons.

Change of Date.

DUE to a very important meeting being called by the War Service Committee of the United States Chamber of Commerce, to be held at Atlantic City on December 4 and 5, it has been deemed advisable to postpone the big highways meeting to the week of December 9 to 13, the joint sessions to be held December 11 and 12. On the 9th and 10th there will be executive sessions of the state highway officials; 11th and 12th, joint session open to the public; 13th, executive session of the state highway officials; morning of the 13th, open meeting of the highway industries, and in the afternoon a meeting of the Highway Industries Association. All the sessions will be held at the Congress Hotel. The program will touch every phase of highway transportation and maintenance. From all indications, this will be one of the most notable conventions ever held.

Association Notes.

At the meeting of the executive committee of the National Association of Sand and Gravel Producers which will be held early in December arrangements will be made for the annual meeting, and methods of procedure will be discussed to bring about the establishment of equitable freight rates. Amendments to the constitution will also be considered with a view to extending the activities of the association.

WE HAVE for some time felt that the sand and gravel producers should have a publication devoted to their special interests, and PIT AND QUARRY fills the requirements.—San Marcos Gravel Co., Inc., San Marcos, Texas.

Stone Production in 1917, $82,215,671

STONE sold in the United States in 1917 amounted to $82,215,671, an increase of 4% over 1916. This increase followed an increase of 6% in 1916 and a decrease of 4% in 1915. The quantity of stone sold in 1917 was approximately 82,800,000 short tons, a decrease of about 9% from that sold in 1916. The increase in value in 1917 was due entirely to the greater value of limestone sold, as the total value of all other varieties of stone sold was less, the decrease ranging from 1 to 11%. An increase of 12% in the value of limestone was due to a large increase in the output of stone quarried for use as furnace flux—from 23,623,508 long tons, valued at $13,946,882, in 1916 to 25,574,146 long tons, valued at $18,679,213 in 1917. The production of limestone sold to industrial works, such as paper mills, sugar factories, glass works, and alkali works, also showed an increase in both quantity and value. The output of limestone for agricultural use, however, decreased 3% in quantity, although it increased 22% in value.

Result of Building Depression.

Continued depression in the building industry in 1917, which affected the better grade of building stone of all kinds, caused a decrease of over 17% in value, and of 30% in quantity. The output for 1917 was 17,263,893 cu. ft., valued at $12,102,914, and that for 1916 was 24,754,742 cu. ft., valued at $14,677,808. The value of paving blocks sold in 1917 was $2,732,444, practically the same as in 1916. This sum represented an output of 48,907,677 blocks having an average value per 1,000 blocks of $55.87. Though figures showing the exact quantity produced in 1916 are not available, a close estimate, based on an exact knowledge of 87% of the output, showed an output of 55,061,840 blocks, a decrease of 11%. The value of both curbing and flagging decreased 13% in 1917, that of stone for riprap decreased 31%, and that of stone for rubble increased nearly 5%. The figures representing sales of stone of these classes are as follows: Curbing, 3,698,275 lin. ft., valued at $1,402,980; flagging, 3,027,115 sq. ft., valued at $356,327; riprap, 2,682,939 short tons, valued at $2,208,373; rubble, 915,646 short tons, valued at $864,321. Crushed stone amounting to 40,285,377 short tons, valued at $29,065,509, was produced in 1917, a decrease of 7,790,204 tons (16%) in quantity and $397,043 (1.3%) in value. The average value

Values of Stone Sold by States.

State or territory.	Total value.	Number of plants.
Pennsylvania	$14,048,158	459
Ohio	6,486,605	162
Vermont	5,920,799	48
New York	5,399,403	156
Indiana	4,449,809	93
Michigan	3,423,825	35
Illinois	3,322,041	82
Massachusetts	3,113,423	107
California	2,911,462	104
Wisconsin	2,787,023	147
Missouri	1,983,300	137
North Carolina	1,896,554	47
New Jersey	1,860,397	72
West Virginia	1,841,071	51
Georgia	1,797,098	35
Minnesota	1,711,318	66
Tennessee	1,635,573	69
Virginia	1,612,118	68
Alabama	1,611,497	29
Maine	1,254,637	40
Connecticut	1,238,684	46
Kentucky	1,118,434	90
Maryland	938,637	42
New Hampshire	921,943	23
Colorado	823,904	47
Texas	697,540	28
Kansas	673,831	57
Florida	654,845	16
Oklahoma	625,048	28
Iowa	520,083	45
Rhode Island	518,785	16
Hawaii	483,453	7
Nebraska	476,307	15
Washington	454,594	26
South Carolina	427,531	15
Oregon	413,867	27
Arkansas	371,732	15
Arizona	319,724	15
Utah	305,968	17
Montana	255,835	15
Delaware	216,346	5
South Dakota	182,907	15
Wyoming	156,180	9
Idaho	94,644	6
Alaska	(a)	1
New Mexico	72,411	5
Louisiana	(a)	1
Nevada	31,625	3
District of Columbia	4,615	4
Mississippi	(a)	1
Undistributed	150,087	..
	$82,215,671	2,647

(a) Included in undistributed.

Quantity and Value of Stone Sold in the United States in 1917

Building stone (cubic feet)	17,263,893	$12,102,914
Monumental stone (cubic feet)	4,058,626	8,102,493
Paving blocks (number)	48,907,677	2,732,434
Curbing (lineal feet)	3,698,275	1,402,980
Flagging (square feet)	3,027,115	356,327
Rubble and Riprap (short tons)	3,598,585	3,072,694
Crushed stone (short tons)	40,285,377	29,065,509
Furnace flux (long tons)	25,574,146	18,679,213
Refractory (short tons)	1,573,573	1,607,743
Manufacturing industries (short tons)	5,446,558	4,070,351
Other uses (short tons)	1,299,887	1,023,013
		$82,215,671

The quantities given above represent approximately 82,800,000 short tons of stone.

VALUE OF STONE SOLD IN 1917, BY KINDS AND USES

1917.	Building	Monumental	Paving	Curbing	Flagging
Granite	$ 3,161,294	$5,704,776	$2,319,598	$ 699,444	(b)
Basalt and related rocks (trap rock)	39,200	.....	52,755	.....	.....
Sandstone	1,043,226	(b)	352,808	651,564	348,000
Limestone	4,115,366	(b)	7,273	51,972	8,327
Marble	3,702,563	2,397,717	.....	.....	.....
Miscellaneous	12,041,265	.....	.....	.....	.....
	$12,102,914	$8,102,493	$2,732,434	$1,402,980	$356,327
Percentage of increase or de-					

(b) Small values included under "other."

	Rubble	Riprap	Crushed	Other	Total
Granite	$ 199,766	$ 583,409	$2,700,620	$ 176,050	$15,544,957
Basalt and related rocks (trap rock)	328,561	506,616	6,600,957	42,796	7,570,885
Sandstone	65,667	263,464	1,400,705	1,386,987	5,512,421
Limestone	270,327	854,884	17,541,098	23,414,132	46,263,379
Marble	.....	.....	.....	330,107	6,330,387
Miscellaneous	.....	.....	822,129	130,248	993,642
	$864,321	$2,208,373	$29,065,509	$25,380,320	$82,215,671
Percentage of increase or decrease for 1917	+4.7	—30.9	—1.3	+38.4	+4.00

(b) Small values included under "other."

was 72 cents per ton in 1917, an increase of 11 cents.

NOT SO MANY PRODUCERS.

The number of plants reporting operations in 1917 was 2,617, which was 388 less than in 1916. A large number of the small quarries were closed on account of scarcity of labor, increased cost of supplies, lack of local demand, and substitution of cheaper material. Many of the larger producers reported that the demand was very good but that shortage of cars and railroad embargoes on shipments curtailed the output. The increase in the cost of operation was 20 to 75%, and the advance in the selling price was 20 to 50%. Many contracts entered into early in the year were made unprofitable by the constantly increasing costs without change in price. The foregoing statements and the following tables are based on returns received from producers by the U. S. Geological Survey, in co-operation with the State Geological Surveys of Alabama, Florida, Illinois, Iowa, Maryland, Michigan, Minnesota, Missouri, New Jersey, New York, North Carolina, Oregon, Pennsylvania, Virginia, Washington and Wisconsin.

Of the 50 producing states and territories 25 decreased and 24 increased the value of their output. In the region east of the Mississippi 16 states showed increased and 11 decreased value of output; in the region west of this river 8 states showed increase and 11 states decreased value of output.

C. E. BRAINARD, M. E., of the Brainard & Fairchild Engineering Co., consulting engineers, Chicago, is the author of the article on "Conservation of Coal" which appeared in the November issue. His name was inadvertently omitted.

The Chamberlain-Dent Highway Bill

SENATE bill 4993, known as the Chamberlain-Dent bill, introduced in the Senate of the United States October 17, 1918, and referred to the Committee on Military Affairs, is an important measure, not only to those states on whose roads there has been of late a great deal of army motor traffic, or where the traffic carried has been abnormal on account of war activities, but it will help indirectly the good roads movement throughout the entire country. It gives the Secretary of War the right to take over and establish those highways that will be of greatest military value to the country. Everyone interested should write his representative in Congress to aid in having it speedily passed. The full text of the bill is as follows:

A BILL to provide for the taking over, improvement, relocation, construction and maintenance of a system of national highways and state highways, designed to facilitate the movement of troops, equipment, munitions and supplies, and to promote the general welfare of the people of the United States.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

That in order to meet the extraordinary wear and damage to the public highways by reason of their use by or on behalf of the Federal Government and to guarantee that their condition will be such that a continuous service can be made thereof, the Secretary of War is authorized and directed to take over a comprehensive system of roads throughout the United States, designed primarily with a view of facilitating the movement of military troops, equipment, munitions and supplies, but at the same time, so far as reasonably compatible with said purposes, with a further view to accommodating the Postal Service, facilitating interstate and foreign commerce, aiding agricultural and manufacturing pursuits, and promoting the general welfare of the people of the United States. To these ends the Secretary of War shall confer with the authorities having in charge the construction of highways in the several states, and in such conferences shall disclose, so far as reasonably practicable, the outlines of his plans for highways designed for military purposes, to the end that unnecessary duplication of highways be avoided, and that highways constructed for other than military purposes may be in a strategic location wherever reasonably possible.

Sec. 2. That said system may be undertaken and completed in such installments or divisions as may seem to the Secretary of War expedient and desirable.

Sec. 3. That the Secretary of War shall forthwith proceed to take over, improve, construct and maintain such roads of said system of highways as are most necessary to the welfare of the people of the United States.

Sec. 4. That for the purpose of defraying the expenses pertaining to the taking over, improving, constructing and maintaining of the said highway system aforesaid, the sum of $100,000,000, or so much of said sum as may be needed for said purpose, is hereby appropriated, out of any funds in the treasury of the United States not otherwise appropriated.

Sec. 5. That the Secretary of War shall make an annual report to Congress showing the manner in which the provisions of this Act have been carried out and expenditures made thereunder.

Sec. 6. That out of the appropriation made by or under this Act, the Secretary of War is authorized to incur such expense as he may deem necessary for carrying out the provisions of this Act.

Sec. 7. That the Secretary of War is authorized to make rules and regulations for carrying out the provisions of this Act.

Sec. 8. That the term "highways" used in this Act shall include bridges and culverts.

Sec. 9. That this Act shall be in force from the date of its passage.

Baseball Over There.

The more the draft officials did to baseball here the better it flourished in Europe, where it is getting a firm hold on all the Allies. A London visitor tells of a recent game in London, in which East Indians took part. One of these approached the plate at a crucial moment and cried aloud:

"Allah, give thou me strength to make a hit."

He struck out.

The next man up was an Irishman. He spat on the plate, made faces at the pitcher, and yelled:

"You know me, Al."

He made a home-run.

LEWIS A. ADAMS, our assistant superintendent, now with the Quarrymen's Regiment in France—the 28th Engineers—has written me to send him my copy of PIT AND QUARRY. As I want that myself, please send to him direct. —H. E. Adams, superintendent, The Ohio Quarries Company, Amherst, O.

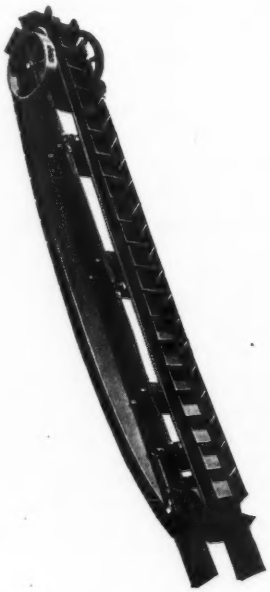
Elevating, Conveying

and

Power Transmitting MACHINERY

for

Gravel, Sand and Stone Plants



SCREW AND BELT CONVEYORS.

BUCKET ELEVATORS, with buckets on chain or belt, furnished with or without steel casings.

BUCKETS—standard types in steel or malleable iron, steel buckets of special design made to your specifications.

GEARS—MACHINE MOLDED or with CUT TEETH.

CHILLED RIM SPROCKETS.

CHAIN—standard malleable detachable, Ley bushel, steel or malleable roller.

SHAFTING, PULLEYS, BEARINGS, FRICTION CLUTCHES.

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H. W. CALDWELL & SON CO.

CHICAGO

Western Ave., 17th and 18th Sts.

MEN AND MACHINERY

Care of Trucks in Winter.

Last winter the service stations were overrun with repairs on cylinders and radiator replacements on account of neglecting to protect the cooling systems. The cost of these replacements, says B. A. Sternberg, of the Gramm-Bernstein organization, aggregated a sum which would have been sufficient to purchase anti-freezing solution for eight winters or more, and he gives some timely advice to truck-owners.

When the temperature drops to zero and below, the use of one part of alcohol (wood or denatured) is advised, with every two parts of water, giving careful consideration to the fact that alcohol evaporates, and a little must be added now and then to maintain the proportional mixture.

Another good solution is mixing two pounds of calcium chloride to every gallon of water where the temperature is about 15 degrees above zero. At zero and 15 degrees below use four pounds to every gallon of water. It is most important to purchase the best grade of calcium chloride, inasmuch as the better the quality, the less the presence of acid.

The use of glycerine is deprecated because it not only produces a bad odor, but also affects the rubber tubing and connections, thereby causing trouble.

Before supplying the cooling system with the solution, it is advisable to remove the bottom crank-case, clean it thoroughly with kerosene, inspect the oil feed line and remove all dirt. See that the screen by the oil pump is in good condition, and test the oil pump. Thoroughly clean the cooling system with soda—wash out and drain several times before adding solution.

Remove all carbon from the motor, grind the valves and make all necessary adjustments.

Refer to the instruction book on the proper kind of oil to use for the winter. If you have no instruction book, ask the local dealer and follow all the instructions as they are set forth.

House your truck in a warm place, and when starting a cold motor, allow it to throttle at a low speed, until all of the oil has thinned.

Observing the above precautions will assure a serviceable truck for the winter; neglect of them will cause expense and delays.

Wire Rope in Winter

If you use wire rope on equipment that cannot be operated in winter because of the weather, it will be a highly economical move to see that it is correctly lubricated b e f o r e being stored.

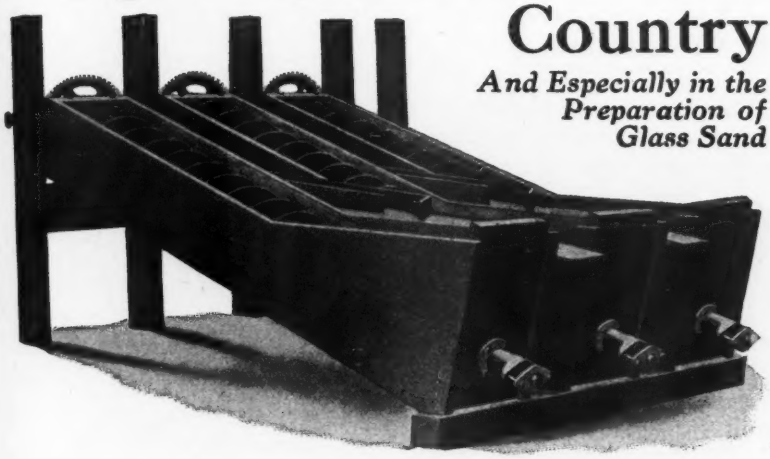
Rust is a worse destroyer than wear, so a wire rope not in use should be thoroughly coated with lubricant that will protect it from water, moisture, acids and other destructive agents. The scarcity of all steel products at this time makes it very necessary to employ every conservative means.

Machinery and Manpower.

In the latest of the interesting series of pamphlets on "The Mineral Industries of the United States" issued by the U. S. National Museum, Messrs. C. G. Gilbert and J. E. Pogue point out that modern civilization is founded upon the work of machinery, as ancient civilization was upon that of slaves. The power utilization of the United States is estimated at 150,000,000 horsepower, and one horsepower is assumed to be equivalent to 20 man-

Used in Some of the Largest Quarries in the Country

And Especially in the Preparation of Glass Sand



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Sand Washers

These are reasonably priced, well built, compact outfits, which can be easily and quickly installed. They are simple in construction and efficient in operation. Extensively used in the manufacture of glass sand which is so much needed today in the making of optical lenses for field glasses, telescopes, etc., required by the Government.

If you are not acquainted with Lewistown equipment and service, it will pay you to look into it.

We are in position to assist you solve your problem of whatever nature, if it pertains to crushing, grinding, screening, washing, drying and conveying, as we manufacture a full line of this machinery and equipment. Drop us a line stating what you desire information on.

Lewistown Fdy. & Machine Co.

LEWISTOWN, PENN.

power. On this basis, the work annually done in the United States, or at least the equivalent in such kind as men could perform, would require the labor of 3,000,000,000 hard-working slaves, and the use of power gives to each man, woman and child in this country service equivalent to that of 30 servants.

Gramm-Bernstein Agencies.

The Gramm-Bernstein Motor Truck Co. announce the following changes in their sales organization:

The W. W. Phelps Motor Corporation, Birmingham, Ala., have been appointed to replace the agency formerly held by the Newell Auto and Machinery Co.

The Altoona Overland Company, Altoona, Pa., Mr. F. E. Frey, manager, have taken on the Gramm-Bernstein line for Central Pennsylvania.

Capitol Motors Corporation, Richmond, Va., are new distributors for the line in Richmond, Va.

The Peoples Motors Company, Louisville, Ky., are new distributors in Louisville and vicinity.

The Cincinnati Oakland Company (H. L. Gordon, treasurer and general manager, and L. E. Manley, secretary and sales manager), will cover Cincinnati, part of Ohio, Indiana and West Virginia, and also Kentucky.

Slag for Road Construction.

For a number of years blast-furnace slag has been used for the construction of roads and as a macadamizing agent. If properly selected, it forms a very good foundation, but should be placed at an incline in such a manner as to hold each lump upon its adjacent lumps, to prevent rocking, and then should be covered over with fine blast slag and properly rolled and consolidated afterwards. It is also successfully used with tar and other bituminous materials for footway and sidewalk paving. As a concrete aggregate it is a very good material, if clean, but it takes almost double the quantity of cement required with river gravel as an aggregate. Owing to its very absorbent nature it also requires greater care in mixing, and for this reason some engineers will not use it if other aggregates are available. It is principally used in this connection for floors of warehouses. When once set, concrete made from blast-furnace slag is very tenacious, and it is almost impossible to break it up with pick or bar.—*Scientific American.*

Price for Crushed Stone.

At a meeting of the Price-Fixing Committee held on Thursday, November 7, a maximum price of $1.50 per ton (2,000 lb.) f. o. b. cars plant was fixed for all Government purchases of crushed stone (other than railroad ballast or screenings) for the period ending December 31, 1918, within the metropolitan Philadelphia district, i. e., for the State of New Jersey, south of and including Trenton; the State of Delaware, and the State of Pennsylvania, east of and including Harrisburg.

Trade Literature.

THE Aero Pulverizer Company, 120 Broadway, N. Y., presents bulletins 26 and 27, both on the subject of Pulverized Fuel Combustion. The Aero Pulverizer, manufactured by this company since 1903, is described and illustrated.

MANGANESE steel wearing parts for tractors are the topic of a handsome illustrated booklet just issued by the American Manganese Steel Company. Besides describing these special products, it gives some instructive information about manganese and its uses.

BULLETIN 156, "The Diesel Engine, Its Fuels and Its Uses," by Herbert Haas, has just been issued by the Bureau of Mines, and may be obtained free of charge while the present supply holds out. The lesson in economy in power production which America is being forced to learn under war conditions is inclining larger numbers daily to consider the claims of the more efficient engines.

Hendricks' Commercial Register

The twenty-seventh annual edition of Hendricks' Commercial Register of the United States for Buyers and Sellers has just been issued. This standard publication is especially devoted to the interests of the electrical, engineering, chemical, hardware, iron, mechanical, mill, mining, quarrying, railroad, steel, architectural, contracting and kindred industries. Full lists are included of producers, manufacturers, dealers and consumers, listing all products, from the raw material to the finished article, together with the concerns handling these products, from the producer to the consumer. There are 2,537 pages of text matter and the index to trade classifications numbers 156 pages. covering over 50,000 trade references. The list of trade names, brands, titles of identification, etc., numbering 215 pages, furnishes ready reference to distinctive products manufactured by concerns listed in the work. The alphabetical section contains in one alphabetical list the name, trade description and address of every concern appearing in the book. Published by the S. E. Hendricks Company, Inc., 2 W. 13th St., New York City. Price $10.00.

The City of Providence, R. I., Was So Well Pleased With This Outfit That

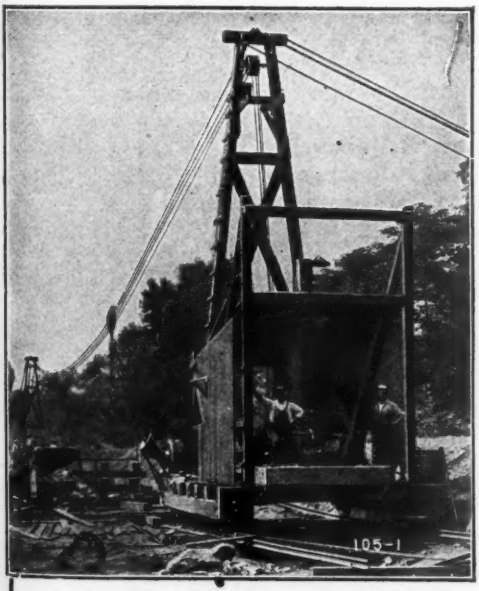
They Bought Another One

and that is as good an endorsement of

THE HAISS DIGGING WAGON LOADER

as any prospective purchaser needs. However, we can supply you with ample evidence of the satisfaction this digging loader is giving to users all over the country. It will load a cubic yard in a minute at a cost of 1c. Can you afford to go on with hand shoveling especially under present labor conditions? Details are yours on request.

The George Haiss Mfg. Co., Inc. 142d St. & Rider Ave., New York



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Steam Shovels

Special attention is called to the following thoroughly overhauled shovels. Good as new.

Marion 70—2½-yard dipper
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Marion 60—2½-yard dipper
Bucyrus 70C—2½-yard dipper
Bucyrus 35B—Full revolving, caterpillar traction, two dippers, 1—1½-yard, 1—1¼-yard.

LOCOMOTIVES

1—20-ton, 11x16″ Dinkeys, 36″ gauge
3—18-ton, 10x16″ Dinkeys, 36″ gauge
2—15-ton, 9x14″ Dinkeys, 36″ gauge
2—10-ton, 7x12″ Dinkeys, 36″ gauge

DUMP CARS

20—12-yard Western Standard gauge air-dump
75— 4-yard Western 36″ gauge, steel beam
50— 4-yard Western 36″ gauge, wood
13— 4-yard Oliver, wood beam, 36″ gauge

PUMPS

1—Novo Centrifugal Pump, 4″ suction, 4″ discharge
1—F. M. Centrifugal Pump, Size 5.
3—Emerson No. 3 Pumps
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Quarry Specialties
GUARANTEED

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1—No. 4 Gates Style K
2—No. 5 Austin
1—No. 5 Gates Style D
1—No. 6 Gates Style D
1—No. 6 Gates Style K Complete plant
1—No. 7½ Austin Complete plant
1—No. 8 Gates Style K
1—No. 9 Gates Style K
2—No. 12 Gates Style K
2—15x24 Traylor Jaw Crushers
1—20x24 Traylor Jaw Crushers
1—10x20 Blake Jaw Crushers

ELEVATORS

1—No. 5 Gates 60' Centers
1—No. 6 Gates 60' Centers
1—No. 7½ Austin 60' Centers
1—No. 9 McCully 60' Centers

SCREENS

2—32x 9 Austin.
1—40x14 Gates
1—48x18 Austin
1—60x20 Gates

RAIL

1,000 tons 45-lb. Relayer
300 tons 35-lb. Relayer
10,000 feet 24" gage Koppel Track

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1—25 H. P. Vertical
1—50 H. P. Vertical Ohio
1—40 H. P. Firebox on trucks
1—80 H. P. Firebox on skid
2—300 H. P. Water Tube

ENGINES

1—22x42 R. H. Vilter Corless with condenser and pump
1—14x22 Vilter Corless
1—60 H. P. Erie
1—80 H. P. Buckeye
1—125 H. P. Buckeye
2—200 H. P. Hamilton Corless
1—500 H. P. Vilter Corless and others

COMPRESSORS

1—Imperial XB2, Ingersoll Rand, capacity 2,400', belt driven
1—Laidlow Dunn Gordon, 2 stage, capacity 600', belt driven
1—Bury, 2 stage, capacity 400', belt driven
1—Sullivan, 2 stage, 1,800', steam driven
1—Ingersoll Rand, 2 stage, 1,000', steam driven
2—Bury Duplex 500' capacity each

CARS

30—2¼ yd. Steel Austin end dump
15—2½ yd. Gates Austin end dump
20—1½ yd. Western side dump, 36" gauge
30—4 yd. Western side dump, 36" gauge
20—12 yd. Western side dump, standard gauge
50—1½ yd. Koppel side dump, 24" gauge
100—60,000 Capacity Gondolas and Flats, standard gauge

LOCOMOTIVES

1— 9x14 Baldwin, 36" gauge
1—10x16 Vulcan, 36" gauge
1—10x16 American, 36" gauge
2—11x16 Vulcan standard, 36" gauge
2—12x18 Vulcan standard, 36" gauge
2—19x24, 45 ton, 6 wheel switchers
2—19x24 10 wheelers, and others

DRILLS

1—Loomis Well Drill
1—Cyclone Well Drill
1—Star Well Drill
1—Keystone Well Drill
8—3½ Sullivan Tripod Drills

SHOVELS

1—No. 0 Thew Traction, ⅝ yd.
1—No. 0 Thew Standard gauge, ⅝ yd.
1—No. 1 Thew Traction, 1 yd.
1—No. 2 Thew Standard gauge, 1½ yd.
1—Model 41 Marion, 1½ yd.
1—Model 61 Marion, 2½ yd.
1—70C Bucyrus, 2½ yd.
1—95C Bucyrus, 3½ yd.
1—36 Marion Traction, 1½ yd.

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Type A1, ⅞ yd. Thew, revolving, traction type steam shovel. Used very little. Absolutely as good as new. Real bargain for quick sale.

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Used Plow and Crucible Steel Cable

Have sold four carloads this season and have on hand 40,000 feet in various sizes and lengths, 6x7 and 6x19 construction, all carefully selected, 90% efficiency. Will ship subject to inspection.

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Crushed stone plant in Central New York. Exceptional production facilities and quality of stone for fluxing and commercial purposes. Market for entire production. Labor and material guaranteed. Address N. S., care Pit & Quarry, Chicago.

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LOCOMOTIVES—CARS—CRANES
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WANTED, SALESMAN

One who is familiar with sand and gravel machinery and with experience in selling to sand and gravel producers. Address R. D., Care PIT & QUARRY.

FOR SALE

Locomotives
3-Std. gg. 6 wheel
switches—18x24 cylinders
excellent condition.
THE FRED R. JONES CO.,
139 N. Clark St., Chicago, Ill.

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One who is familiar with the PIT & QUARRY field. Write fully.
M. B., Care PIT & QUARRY.

No. 8 and 5
GATES STYLE D CRUSHERS

12x24 and 9x18 Jaw Crushers.
Cyclone traction steam drill, 5½" holes.
Link belt wagon loader with motor.
Western, 12-yd., 6-yd., 4-yd. dump cars.
Ingersoll, 1900', 1200' and 500' cap. air compressors.
7x10 Mundy 3-drum hoist with boiler and swinging gear.

DONAHUE & CO.
20 W. Jackson St. CHICAGO

Wanted—Superintendent at a large Ohio Quarry producing 2,500 tons crushed stone daily with capacity for considerably more. Responsible man of executive ability and large experience to take entire charge of plant. All year proposition. High class responsible company. Address P. D., care Pit & Quarry.

Wanted

One second-hand No. 4 Gates Crusher. Must be of late make and in good condition. Address —Belvidere Stone Company, Belvidere, Illinois.

Complete Gravel Plant Equipment for Sale

Complete gravel plant, including ¾-yd. Pioneer back-dump bucket, 7x10 D. C. D. D. hoist, rotary washer, cable, etc., ready to set up and operate. In splendid condition——a bargain for immediate sale.

Also some real bargains in sand and water pumps, at prices that make it worth your while to invest now for future needs.

Mansfield Engineering Co.
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Immediate Delivery

NEW TOOL STEEL

2¼ in.—Jessop's Cruciform Steel

1¼ in.—Jessop's Special Drill Steel

1½ in.—Jessop's Special Drill Steel

1⅜ in.—Jessop's Special Drill Steel (octagon)

Approximately 10,000 pounds

DRILLS

4—Ingersoll-Rand Rock Drills, complete with weights and tripods, model No. 54-L. G., shop numbers 19705, 20095, 20391, 22393.

4—Leyner-Ingersoll Piston Type Air Drills, shop numbers 18-12896, 18-12903, 18-12889, 18-12901.

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First National Bank Bldg., Chicago, Ill.

STEAM SHOVEL

Marion Model No. 20 with 1 1-4 yard dipper as good as new. Can make immediate shipment.

CALUMET IRON & METAL CO.

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READY TO SHIP

1—Browning Locomotive Crane, 10-ton, 4-wheel, through shops.
1—Orton & Steinbrenner Locomotive Crane, 18-ton, 8-wheel, M. C. B.
1—Thew Steam Shovel, No. 0, ¾ yd., traction.
1—Thew Steam Shovel, No. A1, ⅞ yd., traction.
1—Bucyrus, 100-C, standard gauge, 4-5 yd.
1—Austin Gyratory Crusher, No. 4, rear drive.
1—Wheeling Jaw Crusher, 10x16, manganese jaws.
3—Baldwin Locomotive, 18x24, 6-wheel swicthers, through shop.

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Air Compressors — Hoisting Engines
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Write for particulars and prices.

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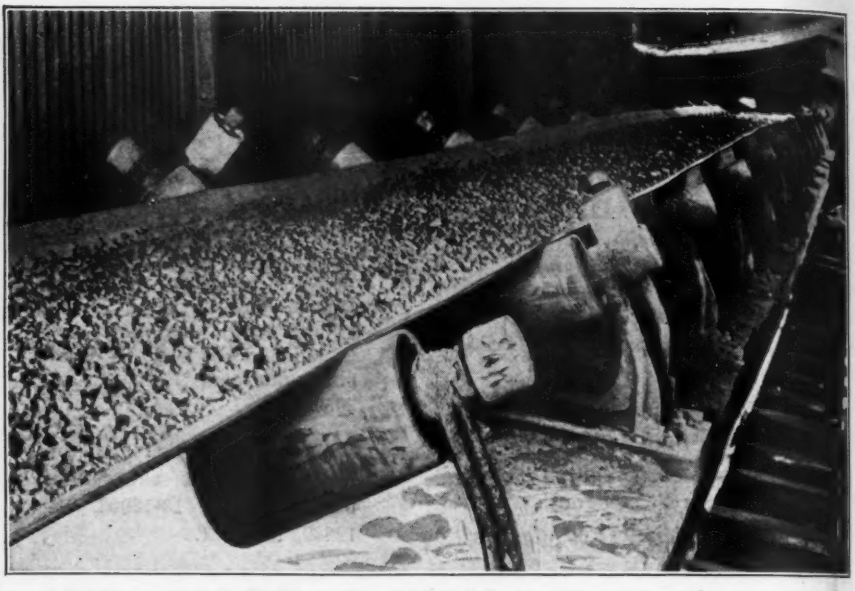

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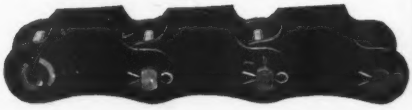

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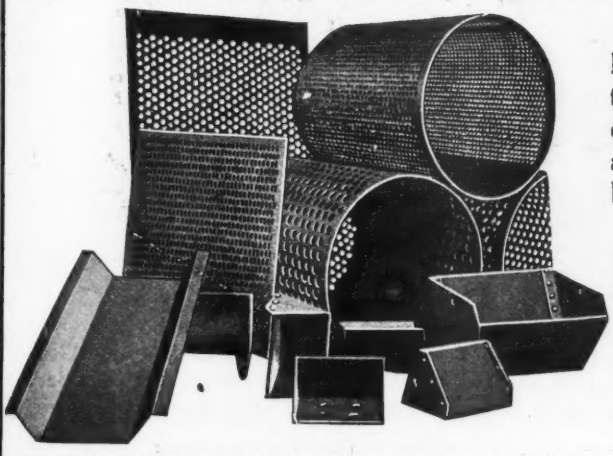

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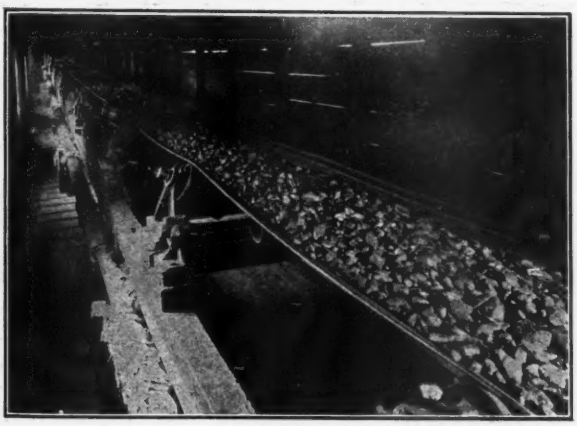

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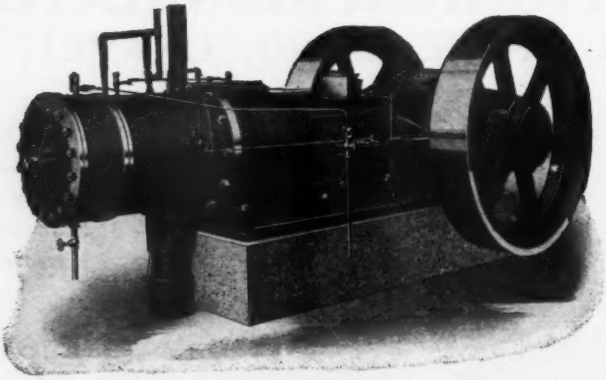

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Small sizes as well as largest ones are designed to give maximum output and greatest wear for a given weight.

Tell us your conditions, giving total vertical lift with length or pipe line, and ask for Bulletin P-33

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A PLYMOUTH Gasoline Locomotive will help *you* to counter rising costs and labor shortage, both at one stroke. It will put your business on a real efficiency basis and will help prepare you to handle the rush seasons as they arrive.

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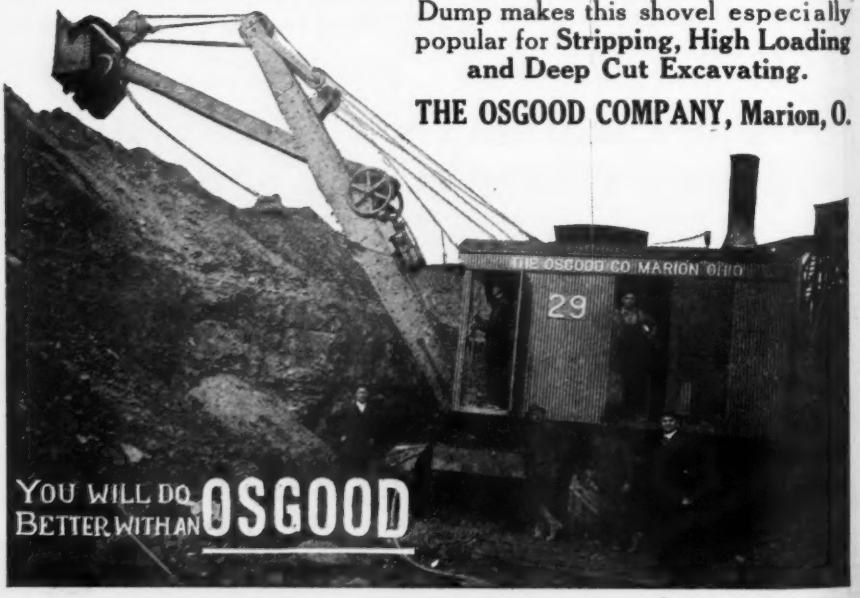

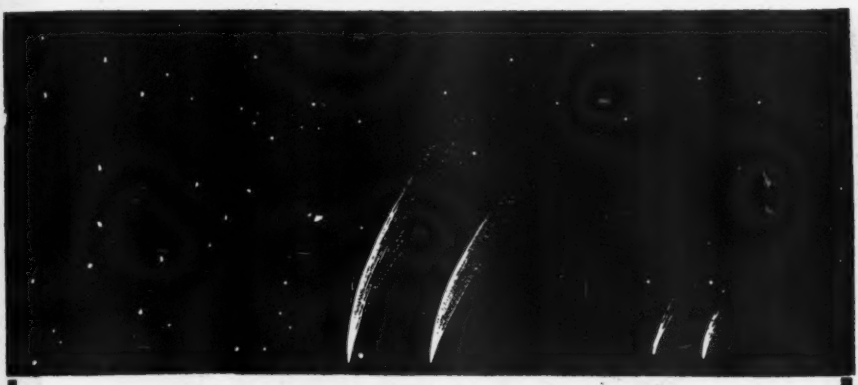

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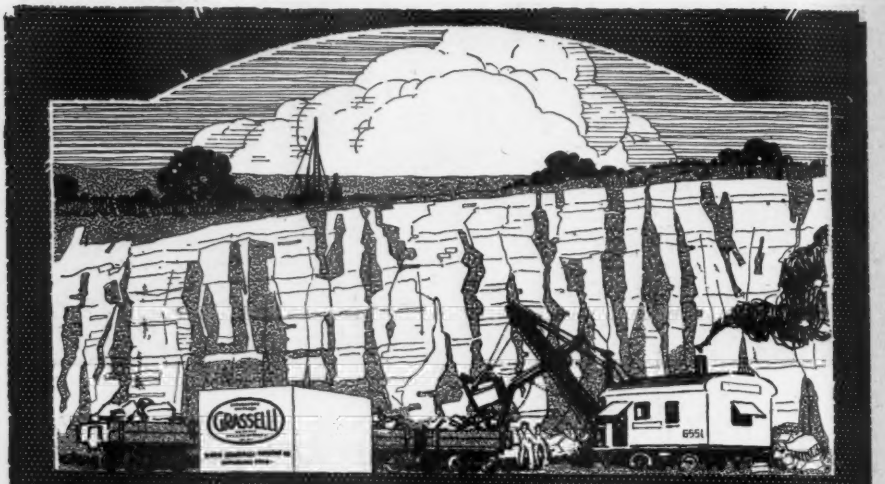

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THE "Grasselli" organization may be oversold on its physical product but it can never be oversold in the good opinion of its customers, their confidence or their good will.

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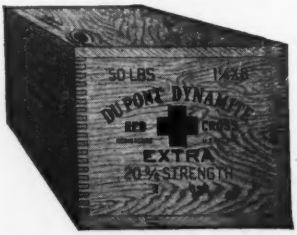
Keep the Quarries Going All Winter



THE maintenance of highways for war-time trucking calls for stone and more stone. There should be no let-up at the source of supply. The use of Red Cross Explosives in quarrying will enable blasting operations to proceed without interruption through the coldest weather. There are few blasting jobs that cannot be accomplished by

Red Cross Explosives

and they have the added advantage of being low-freezing.

Extensive field study has brought to the Du Pont Company an intimate knowledge of quarry problems and their solution.

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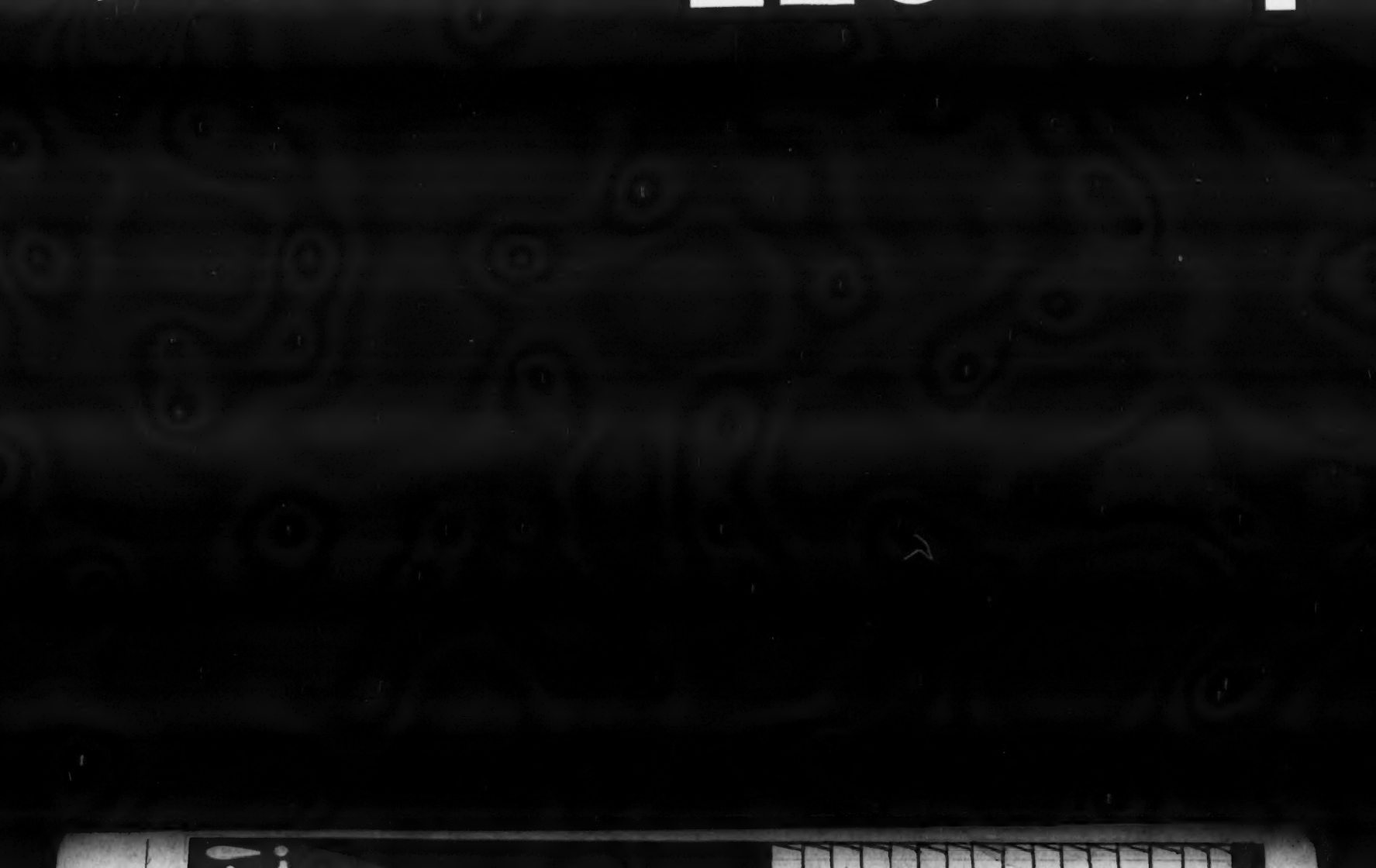

subsequent separation may be accomplished by either of two methods.

According to the first method the rock fragments are loaded into cars by hand, and accumulations of debris are loaded in the same way. For small quarries such procedure may be justified, but under conditions of labor shortage the method is too slow and laborious to be recommended for quarries of any considerable size.

The second method is in common use in the larger quarries. The rock fragments, together with waste material, are loaded with a steam shovel, a method that is economical of labor, and the separation of good rock and waste is accomplished by screening or by washing in conjunction with screening. From the standpoint of labor saving, this method is greatly to be preferred. One objection to the method is the waste that results from the finer rock fragments passing through the screens with the debris, though this waste may be partly overcome by screening the rock to various sizes and discarding only the finest grade of material.

Removal of Overburden Before Quarrying.

While shooting down rock and overburden together, and subsequently separating them by sorting, screening or washing, may, as stated above, be justified under certain circumstances, the removal of overburden prior to rock blasting offers definite advantages.

In their natural occurrence serviceable rock and waste material are as a rule distinct, and are separated by a well-defined boundary. An exception to this rule is the occurrence of clay seams or pockets in the rock ledge. Where any considerable amount of debris is originally unmixed with the rock, it is obviously a poor policy to mix rock and waste by blasting them down together when their subsequent separation is demanded. It involves unnecessary handling of waste, and in rainy seasons the presence of sticky clay with rock impedes operations and renders separation difficult. A better plan is to remove overburden as completely as possible before blasting the rock ledge.

Various methods in common use for the removal of stripping have been described in other publications of the Bureau of Mines. The purpose of the present publication is to give special consideration to their respective labor requirements.

Various Methods Compared.

Loading waste material into dump carts or cars with hand tools is doubtless recognized by most quarrymen as involving the most prodigal use of labor, per ton of material removed, of any method in common use. Fortunately, it is not commonly employed except in very small quarries.

Where the overburden rests on a reasonably smooth rock surface, and the dumping ground is near by, the employment of teams and scrapers results in a pronounced saving of labor over hand methods. Where the waste must be moved a considerable distance a method has been noted whereby the scraper loads are dumped through an opening into wagons on a depressed roadway, the soil being thus handled in two operations. Under such circumstances wheeled scrapers are to be preferred, for thus a single operation will suffice, and such simplification reduces the labor requirement.

A drag-line scraper alone has been used effectively where conditions are favorable, and a drag-line scraper used in conjunction with dump cars, as described in Bulletin 160, may be used to advantage. By either method the heaviest burden of the work is accomplished by machinery, and the labor requirement is not high.

The most popular stripping equipment for large quarries is the steam shovel. It requires a small gang of men, and when properly handled and well supplied with cars can load a great mass of material in a day. Efficient service depends on strong mechanical construction, adequate care, and operation by a skilled runner. Where inefficiency in steam shovel operation is in evidence it usually results from inadequate car service for removal of loaded material rather than from improper handling of the steam shovel itself.

While the first cost of a steam shovel is high, with proper care the cost of maintenance is not excessive. Where the rock surface is fairly uniform and level the steam shovel is probably the best equipment for loading any considerable thickness of overburden.

A stripping conveyor to be used in conjunction with a steam shovel is illustrated and described in a former publication. Such equipment cannot

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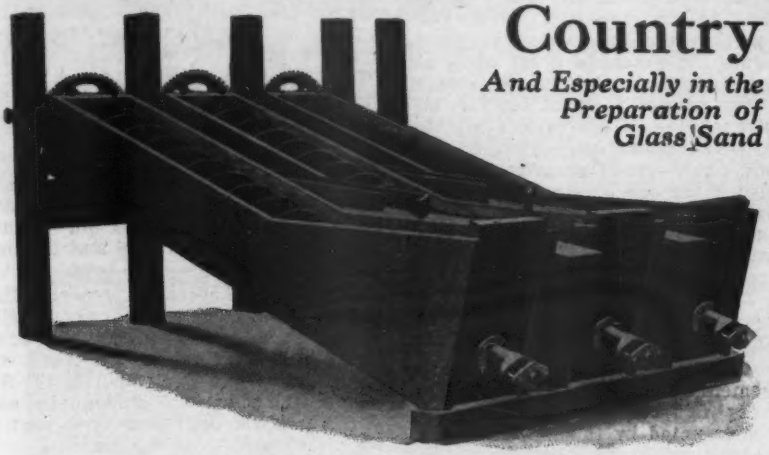

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These are reasonably priced, well built, compact outfits, which can be easily and quickly installed. They are simple in construction and efficient in operation. Extensively used in the manufacture of glass sand which is so much needed today in the making of optical lenses for field glasses, telescopes, etc., required by the Government.

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be generally employed, for it is applicable only to quarries where the overburden may be conveniently disposed in the pit formed by removal of the good rock.

With adequate water supply, proper drainage, and sufficient waste-disposal area, hydraulic stripping is probably the most economical of labor of all methods in common use. With two men at the pumping station and two to handle the nozzle, a great mass of debris may be washed down in a single day. The rate of removal depends on the size of the nozzle, the available water pressure and the consistency of the soil. The rate of progress may be retarded if the overburden is hard, for it may be necessary to bore it with a soil auger and blast with powder. The presence of numerous boulders may also render hydraulic stripping difficult.

As labor is the chief cost item in stripping, the cost per cubic yard is a fair indication of the relative labor requirements of various processes. The following figures representing minimum costs noted by the writer during field investigations may be of interest in this connection: Hand shovel and dump cart method, 30 cents per cubic yard; steam shovel and cars hauled by dinkey engine, 16 cents; steam shovel and stripping conveyor referred to above, 3 cents; drag-line scraper (to loading platform only), 3 cents; hydraulic stripping, 3 cents.

Labor Economy in Drilling.

For multiple-bench or snake-hole quarrying tripod drills are generally used, though of late years large hammer drills have been used successfully by many operators. For ledges not exceeding forty feet in thickness wagon drills are successfully employed in a few localities. For single-bench quarrying, with the quarry face twenty-five feet or more in height, churn drills are now widely used.

Tripod drills require two men each, a runner and a helper, except that in some instances one helper is deemed sufficient for two drills. Hammer drills require no helpers, and are, therefore, more economical of labor than tripods. Wagon or churn drills usually require two men each, though some electrically operated churn drills employ only one man each.

The churn drill, while it is a comparatively recent type of equipment in limestone quarries, is rapidly gaining in favor and is in successful use in a great many places. While there are conditions where it is claimed that other types of drills render better service, from the standpoint of labor requirements the churn drill has this advantage, that it accomplishes the work of four or five tripods or hammer drills with no greater labor than is required for a single tripod. A quarry operator in Pennsylvania claims that one churn drill, one tripod and one hammer drill accomplish as much as was formerly done in the same quarry with five tripods and three hammer drills. Estimating the labor requirement conservatively, the old method would require eleven men and the new method five.

One Texas operator reports that when he employed five tripod drills his plant was frequently shut down through lack of rock; and when one churn drill was substituted for the five tripods the plant was continually supplied, and the drill was used part of the time only.

As in the case of stripping, the relative direct cost of drilling with various types of equipment is a fair measure of their relative labor requirement. S. R. Russell,* in an article entitled "Loading and Shooting Big Blast Holes," estimates that the average cost of steam tripod drilling is about 8 cents per cubic yard of rock quarried, while the average cost of churn drilling is about 2 cents. These figures indicate that the churn drill promotes labor economy.

When churn drills are employed, not only is there a decided saving of labor in the actual drilling process, but their employment may also result in a marked saving of labor in other departments. Where tripod drills are employed in deep quarries the face must be worked down in a series of benches. Bench cleaning is, therefore, necessary, and tracks must be moved frequently. One quarryman reports that the introduction of churn drills released fifteen men formerly employed in operations now rendered unnecessary by the introduction of the new equipment.

*"Blast-hole Drilling with Keystone Cable Drills," published by Keystone Driller Co., Beaver Falls, Pa.